# EyeLink 1000 Plus Installation Guide

## Tower, Desktop, LCD Arm, Primate, and Long Range Mounts

*Version 1.0*

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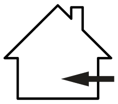
| | |
|---|---|
| ⚠ | Read instructions before use. |
|  | For indoor use only. |
| ETL<br>C US<br>LISTED<br>Intertek | Intertek Safety Mark: Compliance of this product with applicable standards is certified by Intertek, an independent testing agency. |
| | Separate electrical and electronic collection. |
| **CLASS 1 LED DEVICE**<br>IEC 60825-1 (Ed. 1.2:2001) | Illuminators comply with 60825-1 or 62471 safety standards. |
| **CLASS 1 LASER DEVICE**<br>IEC 60825-1 (Ed. 1.2:2001) | Fiber optic interface to OC camera head complies with laser safety standards. |

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NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment can radiate radio frequency energy and may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at the users' expense.

**CISPR WARNING:** This is a Class A product. In domestic environments this product may cause radio interference in which case the user may be required to take adequate measures.

**WARNING:** Changes or modifications not expressly approved by SR Research Ltd. could void the user's warranty and authority to operate the equipment. This includes modification of cables, removal of ferrite chokes on cables, or opening cameras or connectors.

**WARNING:** Opening or modifying cameras and connector will void the warranty and may affect safety compliance of the system. No user-serviceable parts inside - contact SR Research for all repairs.

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## Table of Contents

**1. Introduction ........................................................................................ 1**

1.1 Behavioral Laboratory Installation - Suggested Equipment Layout...... 1

**2. Installation and System Cabling ............................................................ 4**

2.1 Unpacking ........................................................................................ 4

2.2 Pre-Installation Checklist ................................................................... 4

2.3 Setting up the Host PC ...................................................................... 5

2.4 System Wiring.................................................................................... 5

2.5 Camera Lens Selection ....................................................................... 6

2.6 (Optional) EyeLink Response Device Installation ................................ 7

2.7 (Optional) Analog Card Installation ................................................... 8

**3. Tower Mount Installation........................................................................ 10**

3.1 Mounting the Tower to a Table ........................................................ 10

3.2 Mounting the High-speed Camera and Cabling................................ 12

3.3 Adjusting Head Support Components .............................................. 13

**4. Desktop Mount / EyeLink Remote Installation .................................. 14**

4.1 Mounting the EyeLink 1000 Plus High-Speed Camera and Cabling... 14

4.2 Adjusting the Desktop Mount ........................................................... 15

4.3 EyeLink Remote Hardware Adjustment for the Desktop Mount ......... 16

**5. LCD Arm Mount Installation ................................................................ 18**

5.1 Choosing a Table.............................................................................. 18

5.2 Affixing the Arm Base to a Tabletop ................................................. 20

5.3 Assembling the LCD Arm Components ............................................ 21

5.4 Mounting the EyeLink 1000 Plus High-Speed Camera ...................... 22

5.5 Attaching the Cables ........................................................................ 23

5.6 Adjusting the Tension Points on the LCD Arm ................................. 24

5.7 LCD Arm Mount Adjustments for Monocular and Remote Recording. 25

5.8 Disassembling and Transporting the LCD Arm Mount ...................... 25

*5.8.1 Option 1: Remove LCD Arm and Camera Assembly as a Unit............. 26*

*5.8.2 Option 2: Remove Camera Assembly then Remove the LCD Arm........ 26*

**6. Primate Mount Installation .................................................................. 28**

6.1 Primate Mount Hardware Considerations ........................................ 29

**7. Long Range Mount Installation ............................................................ 32**

7.1 Description of the Components ........................................................ 32

7.2 Overview of Setting the Mount ........................................................ 33

7.3 Securing the EyeLink 1000 Plus Fiber Optic Camera Head .............. 34

7.4 Securing the Illuminator ................................................................ 36

7.5 Affixing the Mounting Bar ............................................................... 36

7.6 Cabling for Long Range System ...................................................... 36

7.7 Configuring the Long Range Camera Hardware ................................ 40

*7.7.1 Acquire Preliminary Measurements ........................................................ 40*

*7.7.2 Assemble the Long Range Mount Components ..................................... 41*

*7.7.3 Align the Camera Head and Illuminator ................................................ 42*

*7.7.4 Put the Mount into Position and Find the Eye ....................................... 43*

7.8 Installation in a MEG Room ............................................................ 44

7.9 MRI Installation ............................................................................ 46

*7.9.1 Determine the Mount and Configuration to Use .................................... 47*

*7.9.2 Mounting the Camera Head and Illuminator ......................................... 52*

*7.9.3 The Head Coil Mirror ........................................................................ 53*

*7.9.4 Measuring and Using the Eye-to-Camera Distance ............................... 54*

*7.9.5 Align the Camera Head and Illuminator ................................................ 55*

*7.9.6 Put a Volunteer/Confederate in the Scanner and Find the Eye(s) ....... 55*

*7.9.7 Adjust Image Thresholds and Focus the Lens ...................................... 56*

7.10 Calibration and Drift Correcting with the Long Range System ........... 57

*7.10.1 Calibrating Atypical Spatial Areas ...................................................... 57*

*7.10.2 Drift Correction ............................................................................. 58*

**8. Testing the Host PC Installation ........................................................ 60**

8.1 Host Software Update .................................................................... 62

8.2 Troubleshooting Instructions .......................................................... 63

*8.2.1 SCD file does not exist ....................................................................... 63*

*8.2.2 ERROR: Can't find Gige Camera! ......................................................... 63*

8.3 EyeLink Data Storage ..................................................................... 64

8.4 Customizing Screen Settings .......................................................... 64

*8.4.1 Screen Dimensions ........................................................................... 64*

*8.4.2 Display Resolution ........................................................................... 65*

*8.4.3 Eye-to-Screen Distance ..................................................................... 66*

*8.4.4 Camera-to-Screen Distance ................................................................ 67*

**9. Display PC Hardware and Software Installation .................................... 69**
9.1 Display PC Hardware Installation .................................................. 69
9.2 Windows Installation ....................................................................... 70
*9.2.1 Installing the EyeLink 1000 Plus Experiment Programming Kit........... 70*
*9.2.2 Installing the EyeLink Data Viewer and Experiment Builder Software 70*
*9.2.3 USB License Key Installation ................................................................ 71*
*9.2.4 Setting up 1000 Plus Network Connection ............................................ 71*
9.3 Mac OSX Installation ..................................................................... 72
**10. Appendix A: Optional Host PC Hardware Installation ......................... 75**
10.1 Installing the Data Translation Analog Card (Optional) ..................... 75
10.2 Installing the PCI Express Parallel Port (Optional)............................. 75

## Figures

Figure 1-1: Suggested 1000 Plus System Layout ........................................................ 2
Figure 2-1: Basic Host PC and Camera Cabling ........................................................... 6
Figure 2-2: VPixx Button Boxes (left), VPixx Button Box Parallel Port Pin Adapter, Microsoft Xbox 360 (middle), and Logitech F310 (Right). ....................................... 7
Figure 3-1: Components of the Tower Mount............................................................... 10
Figure 3-2: Clamping Chinrest to Table (right), Placing and Adjusting Tower Mount11
Figure 3-3: Adjust Height of Tower to Half the Screen Area of Monitor ..................... 12
Figure 3-4: Views of the 1000 Plus Tower and Camera ............................................... 12
Figure 3-5: Camera and Illuminator Cables for Tower Mount.................................... 13
Figure 4-1: Install Camera onto the Desktop Mount .................................................. 14
Figure 4-2: Camera and Illuminator Cables from Desktop Mount ............................. 15
Figure 5-1: Typical EyeLink 1000 Plus LCD Arm Mount Installation ........................ 18
Figure 5-2: 1000 Plus LCD Arm Mount Components: LCD Arm Mount Base, Arm, Camera and LCD Assembly ........................................................................... 19
Figure 5-3: Two Configurations of the LCD Arm Mount Base .................................... 20
Figure 5-4: Rearview of the LCD Arm Mount's Camera (top) and LCD Monitor (bottom) ........................................................................................................ 22
Figure 5-5: Cables Emerging from the Bottom of the LCD Arm ................................. 23
Figure 5-6: Securing the LCD Arm for Disassembling and Transporting .................. 25
Figure 6-1: Typical Primate Mount Installation .......................................................... 28
Figure 7-1: EyeLink 1000 Plus Long Range Mount affixed to a Desktop Base (left) and pictured with a variety of lenses and Tripod Adapter (right) ................................. 32

Figure 7-2: Mounting Bar and Clips-note Guide Pins on the Camera Head clip (left)32

Figure 7-3: Fiber Optic Camera Head with lens (left), attached to the Camera Head Bracket (center), Guide Holes in the Camera Head Bracket accept Guide Pins from Camera Head Clip (right) ........ 34

Figure 7-4: Bracket in the Level Position (left) and Angled (right) – without the Camera Head (top) and with the Camera Head (bottom) ........ 35

Figure 7-5: Illuminator attached using two brass thumbscrews (left), or single thumbscrew (center), rotates around the Mounting Bar when its knob is released to adjust tilt (right) ........ 35

Figure 7-6: Tripod Adapter (left), Desktop Base (middle) and Mounting Bar attached to the Tripod Adapter using Two Brass Bolts (right) ........ 36

Figure 7-7: Typical MRI Components and Wiring Diagram-MEG/EEG setups are similar, though power is usually passed through a waveguide. ........ 37

Figure 7-8: Male DB-9 connector (left-to-right), gender changer with female connector showing, BNC connectors, LEMO connectors, and Battery System........ 38

Figure 7-9: Focusing the Illuminator ........ 42

Figure 7-10: Pointing the Camera – a visible illumination boundary indicating poor lighting of the left portion of the camera's view (left) and a fully illuminated target indicating intense and uniform illumination (right)........ 43

Figure 7-11: Screen Mount used in conjunction with the Elekta Neuromag screen (left) and a custom-built wood-frame screen (right)........ 46

Figure 7-12: Tray Mount with optional screen for Siemens Trio (left), Screen Mount (middle), and the mirrored mount for the Siemens Allegra head-only scanner (right) ........ 47

Figure 7-13: Tray Mount for Siemens family of scanners pictured from above with optional screen (left), from behind with screen (top-middle) and configured for user-supplied screen (bottom-middle), riser block on screen (top-right) and from above (bottom-right)........ 50

Figure 8-1: Booting into the EyeLink Partition ........ 60

Figure 8-2: Host Application Camera Setup Screen........ 61

Figure 8-3: Example screen from Web UI Interface displaying File Manager........ 62

Figure 8-4: Updating Host Software through Web UI ........ 63

Figure 8-5: Updating Screen Dimensions ........ 65

Figure 8-6: Updating Display Resolution ........ 66

Figure 8-7: Updating Eye-to-Screen Distance........ 67

Figure 8-8: Updating Camera-to-Screen Distance........ 68

Figure 9-1: Choose "Change Adapter Settings" Option on ........ 71

Figure 9-2: Configure IP address on Windows 7........ 72

Figure 9-3: Configure IP address on Mac OS X........ 74

Figure 10-1: PCI Analog Card .......................................................................................... 75
Figure 10-2: PCI Express Parallel Port Add-on Card.................................................... 76

# 1. Introduction

The EyeLink 1000 Plus is the latest eye tracking system in the EyeLink line, extending the strengths of its predecessor the EyeLink 1000 to set even more new performance standards. The first few chapters of this Installation Guide provide hardware and software installation instructions for the EyeLink 1000 Plus system using the Desktop, Tower, Primate, and LCD Arm Mounts. Chapter 7 covers the optional Fiber Optic Camera Head addition to the 1000 Plus system, which allows the system to track in sensitive environments such as MRI and MEG installations with various non-ferromagnetic optimized Long Range Mounts.

The EyeLink 1000 Plus camera can be extended in several ways to further expand its capabilities. A 2000 Hz Upgrade allows the system to record eye movements at up to 2000 samples per second for monocular recordings or 1000 Hz each eye for binocular recordings. A Remote Upgrade enables the system to be used in one of several Remote mode configurations, each with useful properties tailored to the recording of eye movements from participants without requiring any form of head stabilization. While the 2000 Hz Camera Upgrade is compatible with all mount options, the Remote upgrade works with only the Desktop and LCD Arm Mounts.

The basic steps in installing the EyeLink 1000 Plus system are:

1) Unpacking and setting up the eye tracking hardware for your particular mount and stimulus presentation method,

2) Testing the installation and configuring the 1000 Plus software,

3) Installing and configuring the EyeLink Windows, Mac OS X or Linux Display Software (API and example experiments) on your Display PC.

A complete installation in a behavioral laboratory setting should take under and hour, while initial installation in an MRI or MEG environment could take two hours or more depending on the amount of testing one wishes to perform. If you have questions or encounter a problem during the installation process, please contact SR Research - sending an e-mail to support@sr-research is likely to get the fastest response, though feel free to call our support phone line at the numbers listed on the front page of the manual.

If you would like to ensure that a technical representative is available for direct phone support during your installation, please contact your SR Research representative to book a time for installation phone support. Please try to arrange an installation time with at least one week's notice.

## 1.1 Behavioral Laboratory Installation - Suggested Equipment Layout

The layout of the EyeLink 1000 Plus equipment in the Behavioral Laboratory is important if participant setup is to be convenient, and lighting problems are to be avoided. Before setting up the equipment, check the arrangement of the room to be used against these suggestions. These will aid in the ease of acquiring good experimental data.

- Ideally, arrange the Host and Display PC monitors on tables in an 'L' shape, as in Figure 1-1. This configuration allows the experimenter to adjust the eye tracking device and set up the subject for the experiment while having access to both computer keyboards and monitors.

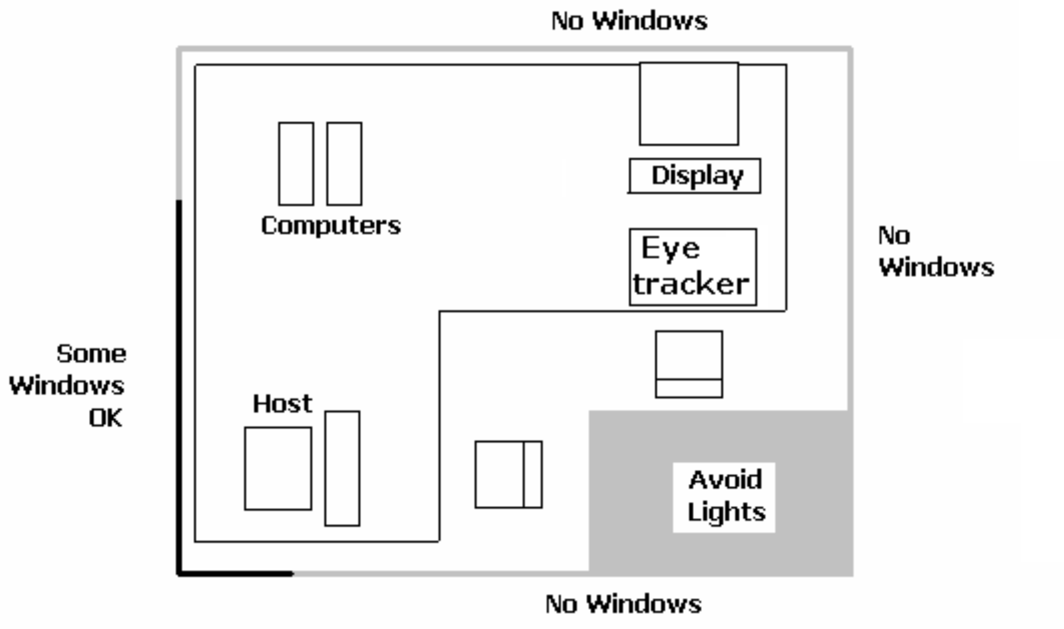


*Figure 1-1: Suggested 1000 Plus System Layout*

- If you are using the SR Research head support, please make sure you have a sturdy table available to clamp the chinrest to. This table must have a minimum thickness of 1.8 cm and a maximum thickness of 8.0 cm. The bottom edge of the table should have a depth of at least 6.0 cm to mount the integrated table clamp.
- Ideally, the table you select should be deep enough to accommodate both the monitor (especially for a CRT monitor) and eye tracker. For a 21" CRT monitor with a 30° viewing angle, the minimum table depth should be about 130 cm. A high table will ensure that even the tallest participants do not need to hunch over in order for their view to be aligned with the top of the Display monitor.
- Avoid windows or other bright light sources that could cause reflections on the host and display monitors. The grey walls highlighted in Figure 1-1 are locations where bright light sources will cause reflections.
- Supply sufficient light in the room. The best way to light the room is with ceiling-mounted fluorescent lights, above and no more than two meters behind the computer monitors. Painting the walls light colors or white will maximize ambient light as well.

- Avoid environmental distractions. Be sure the room can be kept quiet, that no distracting items are viewable by the participant, and so on. It is a good idea to ensure that the participant cannot see the host monitor without turning their head (discourage this).
- Supply a comfortable, stable chair for the participants. It should not wobble or move when sat in, and the back should be firmly attached to the seat - springiness encourages some participants to rock forwards and back. A chair with a concave back also discourages shifting of the body, as does a high back. The top of the chair back should be just below the shoulders on an average participant. Finally, make sure participants can enter and leave the chair easily, as the chair will be close to the table with the Display PC monitor.

# 2. Installation and System Cabling

**Important:** Power off computers before connecting or disconnecting any cables! Ensure that all cabling is properly connected and connectors are properly secured to the Host PC and the EyeLink 1000 Plus camera before use.

**Warning:** Static Electricity Discharge may cause permanent damage to your system. In order to avoid possible static electricity discharge during installation, please discharge any static electricity accumulated in your body by touching a grounded metal surface or the computer case for a few seconds.

## *2.1 Unpacking*

Unpack all of the items you have received from SR Research Ltd. If the system has been stored or transported at a temperature below 10°C, allow all parts to warm to room temperature before proceeding.

If you are unpacking the Tower Mount, please be careful as it contains glass that may have been broken during shipping.

**IMPORTANT: The Tower assembly should be held by the vertical posts and should NEVER be held by the mirror or the components attached to the mirror.**

## *2.2 Pre-Installation Checklist*

Ensure that you have the listed components available before you start installation:

1. EyeLink 1000 Plus High-speed Camera.
2. 12V Power supply for the EyeLink 1000 Plus Camera.
3. EyeLink 1000 Plus Mount, which can be Desktop, Tower, LCD Arm, Primate Mounts, and Long-range mount. Each type of Mount consists of an infrared illumination source, an apparatus for holding the EyeLink 1000 Plus camera, and lens specific to the Mount. Each Mount option has a separate chapter to be consulted regarding its installation.
4. Fiber-Optic Camera Head if you purchased the Long-range mount.
5. Two black Cat6 network cables (6' and 15').
6. Blue Ethernet cable to connect Host and Display PC together.
7. EyeLink Host PC (a Workstation PC or a Laptop PC).

8. USB Ethernet converter if you are supplied with a laptop Host PC.
9. “EyeLink 1000 Plus Software” USB drive.

You will also need the following components:

1. A power strip with surge protection to ensure that your EyeLink receives consistent voltage and to make it easy to power the system on and off.
2. A Display PC that ideally meets the required specifications listed in Section 9.1.

## 2.3 Setting up the Host PC

Your purchase of the EyeLink 1000 Plus system comes with a pre-configured host computer (a Laptop, or a Workstation PC), which require simple setup and the attaching of cables. Set up the Host PC as you would any computer, at the desired location (see Section and Figure 1-1 for a suggested layout). This includes connecting the keyboard and mouse to the computer, as well as the power supply and monitor cables.

If you are supplied with a laptop host computer, make sure you attach the USB Ethernet converter before powering up the computer.

## 2.4 System Wiring

Typical cabling steps for the Host PC are (see Figure below; top panel for a Workstation Host PC and bottom panel for a Laptop Host PC):

1. If not already completed, attach the keyboards, mouse, power cords, monitors etc. to the Host PC and your Display PC.
2. You are supplied with two black Cat6 Ethernet cables (6’ and 15’). Choose one that fits your need. If you are using a Workstation Host PC, plug one end of the network cable to the Ethernet port on the Host PC marked with “EyeLink Camera”; if you are using a laptop computer, plug the network cable to the Ethernet port on the motherboard. The other end of the network cable will be attached to the Camera once it is placed in its Mount.
3. If you use a Workstation Host PC, connect one end of the blue network cable provided with your system to the Ethernet port on the Host PC marked with a “Display PC Ethernet” label. If you are using the Laptop Host PC, the blue network cable should be plugged to the USB Ethernet converter. Connect the other end of the cable to the Ethernet port on the Display PC that you will later configure for use with the EyeLink system. Ensure the cable is securely connected at both ends.
4. Plug the 12V power supply’s small, circular end into the EyeLink1000 Plus camera. Plug the other end of the power supply into a surge protected power source. The camera

is powered as soon as it has an electrical supply, so a power supply with a switch provides a convenient way to turn the camera on and off.

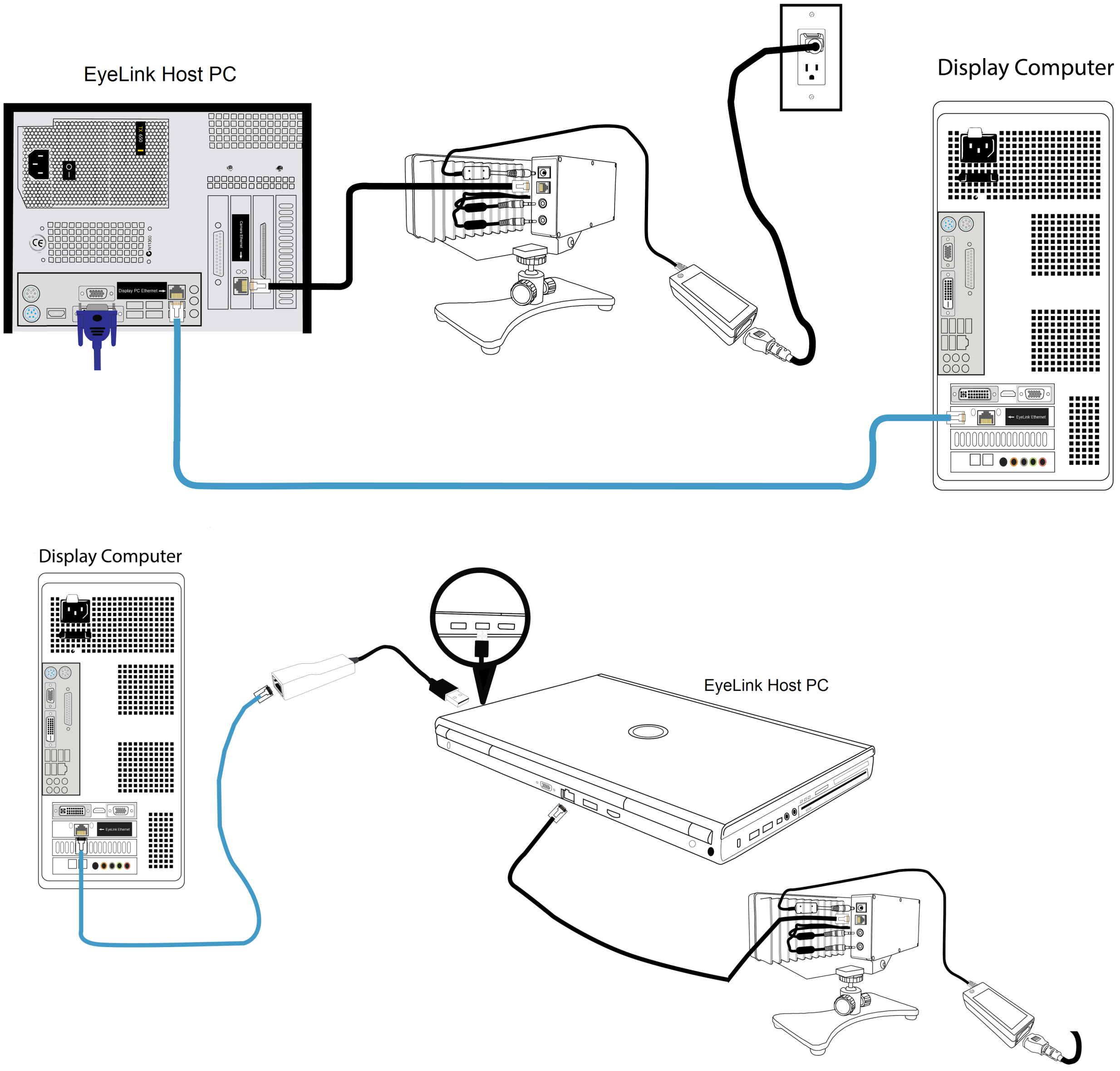


***Figure 2-1: Basic Host PC and Camera Cabling***

## *2.5 Camera Lens Selection*

The EyeLink 1000 Plus Mounts come with a number of different lenses to be used for unique eye tracking situations. Table 1 lists recommended lenses for a range of eye-to-camera distances as a function of the type of mount being used. In all cases, eye-to-camera distance is listed in cm and measured from the surface that the lens screws into to the bridge of the participant’s nose.

| Lens<br>Aperture Size | Tower/ Primate Mount | Desktop Mount or LCD Arm Mount | | Long Range Mount |
|---|---|---|---|---|
| | | with Head Support | Remote Mode | Monocular/Binocular |
| 16 mm<br>(Short Handle or Focusing ring) | - | - | 50-70 cm | - |
| 25 mm<br>(Long Handle or Large Wheel) | IDEAL | - | - | - |
| 35 mm | - | 50-70 cm | - | 60-70 cm |
| 50 mm | - | - | - | 70-100 cm |
| 75 mm | - | - | - | 100-150 cm |

***Table 1. Lens Guide for Different Viewing Distances***

## *2.6 (Optional) EyeLink Response Device Installation*

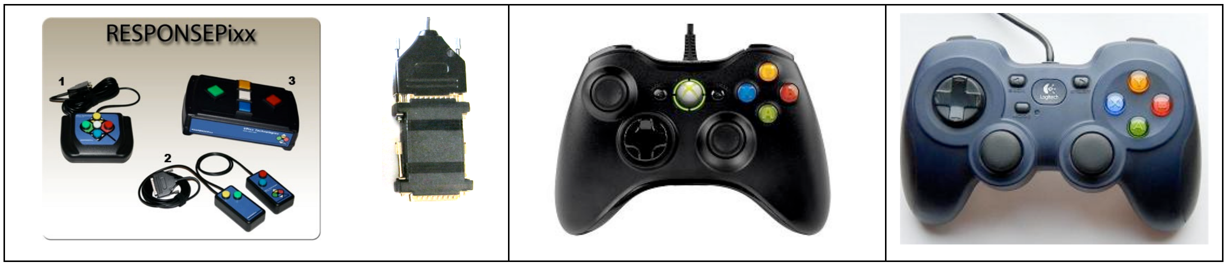


***Figure 2-2: VPixx Button Boxes (left), VPixx Button Box Parallel Port Pin Adapter, Microsoft Xbox 360 (middle), and Logitech F310 (Right).***

If you have purchased an optional button box/response device for the Host PC (VPixx Professional button box, or the Microsoft Xbox 360 gamepad, or a Logitech F310 gamepad - see Figure 2-2) it should be plugged into the Host PC before booting.

***VPixx Professional Button Box Installation.*** The VPixx button box plugs into the parallel port on the Host PC motherboard and requires the additional parallel port pin adapter shown in the Figure 2-2.

***Microsoft Xbox 360/Logitech F310 Gamepad.*** If you have a compatible USB gamepad (Microsoft Xbox 360 Controller, or Logitech F310 gamepad), plug it into a USB port on the Host PC. Use an optional USB extender cable if the game pad needs to have a cord longer than one meter.

> **NOTE:** If you have a USB Button Box, it must be directly connected to a USB port on the Host PC and cannot be connected through a USB hub.

## 2.7 (Optional) Analog Card Installation

If an optional analog output card was purchased with your system it will require additional components (listed below) and cabling steps. The analog card option is only supported on a Workstation Host PC.

- Full length PCI Analog card (already seated in the Host PC if your system comes preconfigured).
- Analog breakout board with BNC connectors.
- Cable to connect the analog PCI card to the breakout board.

The analog card allows position information and pupil size to be output as analog voltages. The card connects to a breakout board using a thick cable, and the breakout board in turn has a number of BNC connectors attached to it. Each BNC connector has a label. See Table 2 for details of the information carried on each line (assuming that the default "analog_force_4channel = NO" setting is used). To reduce noise it is recommended that the breakout board be encased in an RF shielded and insulated box.

| BNC Connector Label | Line | Pins | Eye Data |
|---|---|---|---|
| 0 | DAC0 | 28/27 | Monocular: X |
| | | | Binocular: Left X |
| 1 | DAC1 | 62/61 | Monocular: Y |
| | | | Binocular: Left Y |
| 2 | DAC2 | 30/29 | Monocular: Pupil Size |
| | | | Binocular: Left Pupil Size |
| 3 | DAC3 | 64/63 | Monocular: - |
| | | | Binocular: Right X |
| 4 | DAC4 | 32/31 | Monocular: - |
| | | | Binocular: Right Y |
| 5 | DAC5 | 66/65 | Monocular: - |
| | | | Binocular: Right Pupil Size |
| STST | STST | 4/3 | Strobe Line |

***Table 2: Analog Card BNC Connector Information***

For detailed information regarding configuration and use of the analog card please see Appendix A of the EyeLink 1000 Plus User Manual.

**Continue on to the section pertaining to the mounting option that you are installing:**

**Tower Mount – 3 "Tower Mount Installation"**

**Desktop Mount – 4 "Desktop Mount Installation"**

**LCD Arm Mount – 5 "LCD Arm Mount Installation"**

**Primate Mount – 6 "Primate Mount Installation"**

**Long Range Mount – 7 "Long Range Mount Installation"**

# 3. Tower Mount Installation

Please follow the steps below to mount the EyeLink 1000 Plus Tower Mount onto the table and to install the camera. Figure 3-1 illustrates adjustable parts on the Tower Mount.

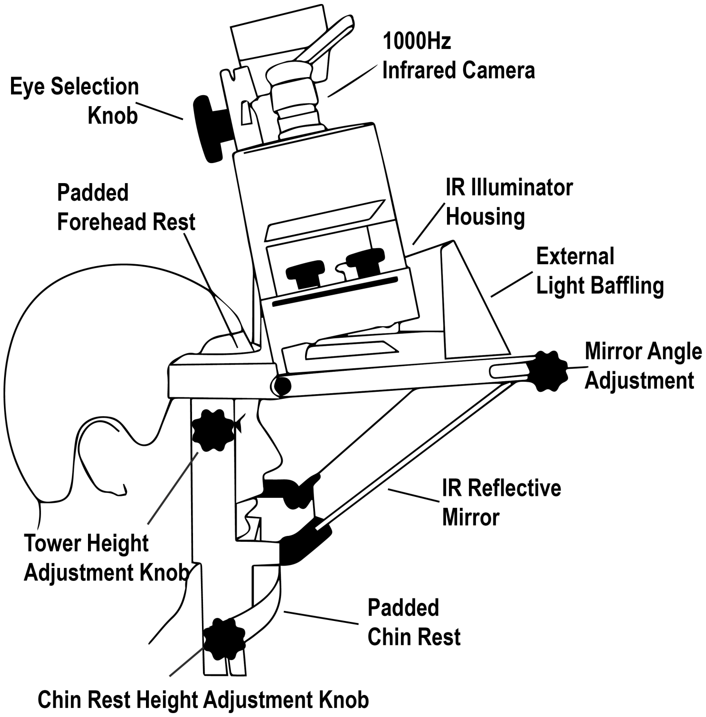

1000Hz
Infrared Camera
Eye Selection
Knob
Padded
Forehead Rest
IR Illuminator
Housing
External
Light Baffling
Mirror Angle
Adjustment
IR Reflective
Mirror
Tower Height
Adjustment Knob
Padded
Chin Rest
Chin Rest Height Adjustment Knob

*Figure 3-1: Components of the Tower Mount*

## 3.1 Mounting the Tower to a Table

**Important: The head support Tower should only be held by the vertical posts and should NEVER be held by the mirror or the components attached to the mirror.** We recommend you have somebody available to assist with mounting the head-support Tower onto the table to prevent damages to the IR mirror or other parts of the Tower.

Check whether the table is suitable for mounting the EyeLink 1000 Plus Tower – the table used should have a minimum thickness of 1.8 cm and a maximum thickness of 8.0 cm.

Loosen the table clamp by turning the knob counterclockwise, then place the table clamp fully onto the table, and then tighten it clockwise (see left panel of Figure 3-2). Check that it is firmly secured by gently attempting to rock the table clamp base free. If the table clamp base wobbles you will have to tighten it further.

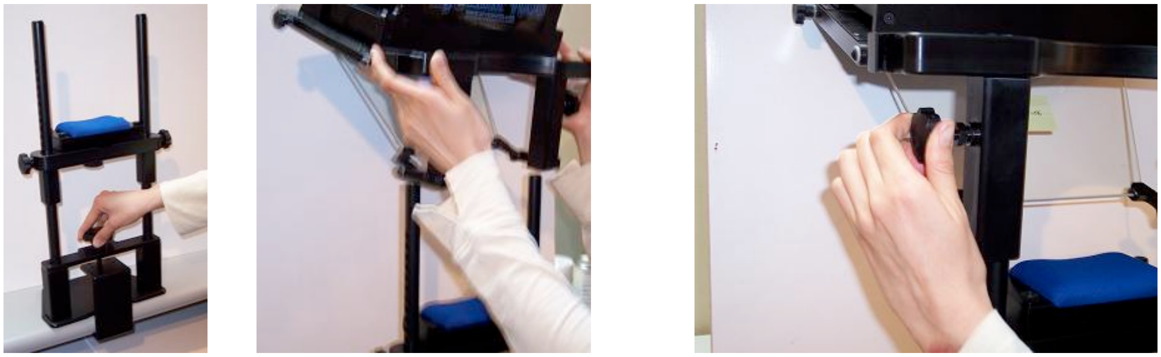


***Figure 3-2: Clamping Chinrest to Table (right), Placing and Adjusting Tower Mount***

The Tower mount is quite heavy and cumbersome to move. For safety purposes it is recommended that two people participate in setting up this piece of the equipment. One person can support the weight of the tower mount while the other lines the spring-loaded clamps with holes in the Tower poles. When released, the clamps secure a peg into the holes of the Tower poles, thereby supporting the weight of the tower mount.

Gently pick up the tower mount with the mirror on the side that is away from you. It is recommended that you hold the tower mount near the height adjustment knobs as shown in the center image of Figure 3-2. Be careful not to scratch or touch the mirror. Now line the mount up with the vertical posts and gently lower it into position. The tower mount should rest about ½ inch into the hole.

Once the Tower Mount is placed onto the poles you will need to adjust its height by simultaneously pulling the height adjustment knobs away from the poles on both the left and right hand sides (see right panel of Figure 3-2). Be careful as you still have to support the weight of the tower mount. Make sure that the unit does not fall down the poles. If at any point the camera mounting unit does begin to fall, releasing the spring-loaded height adjustment will cause them to lock into one set of holes in the Tower poles, preventing the Tower from falling further.

Raise or lower the camera mount by pulling to release the height adjustment knobs and by raising or lowering the unit until the knobs are in line with the center of the display monitor (see Figure 3-3). This will produce an optimal viewing angle for participants. Once the Tower height is set for a normal operation, it does not need to be adjusted further. The experimenter should adjust the heights of the chair and/or chin rest on a participant-to-participant basis.

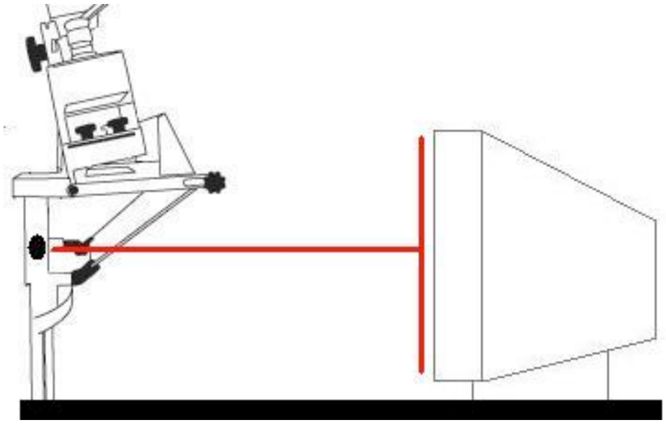


*Figure 3-3: Adjust Height of Tower to Half the Screen Area of Monitor*

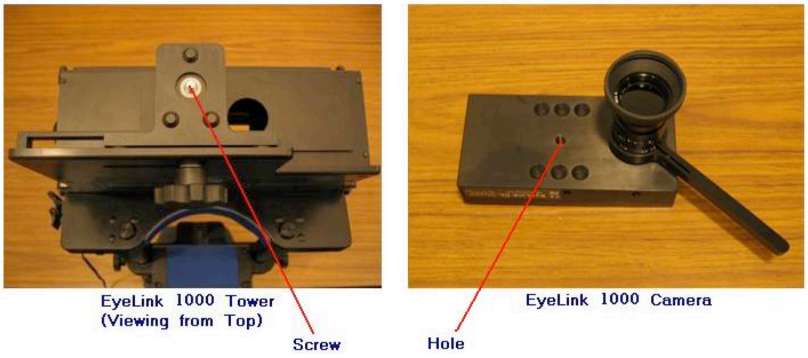


*Figure 3-4: Views of the 1000 Plus Tower and Camera*

## 3.2 Mounting the High-speed Camera and Cabling

The 25 mm lens with a long focusing arm should be used on the EyeLink 1000 Plus Tower Mount. Remove the cap from the camera lens. Remove the orange protective cover plugged to the camera as well. Turn the camera lens into the thread on the camera.

Hold the camera with the lens facing down so that the focusing arm is on the right. Align the hole on the camera to the screw on the top of the Tower and tighten the screw knob from below. Please make sure the camera lens is not dusted or scratched!

After the camera is installed onto the tower mount, connect the two illuminator cables that come out of the left side of the head support Tower to the left side of the EyeLink 1000 Plus high-speed camera: plug the cable marked with “R” to the port marked with “R” and the one with “L” to the remaining port. Plug in the black Ethernet cable to the Ethernet port on the high-speed camera. Connect the camera power supply that was provided with your system to the power connector on the left side of the EyeLink 1000 Plus camera.

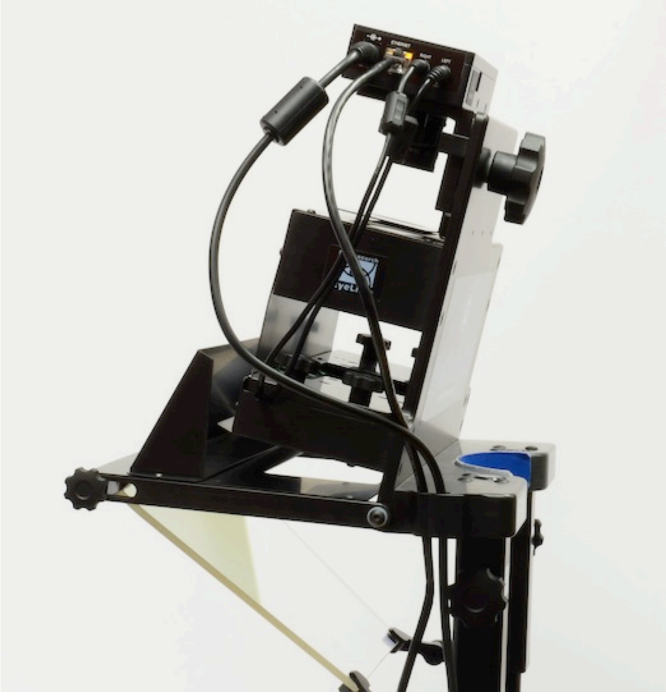


*Figure 3-5: Camera and Illuminator Cables for Tower Mount*

## 3.3 Adjusting Head Support Components

The height of the forehead and chinrest can be adjusted by loosening the knobs on both sides of the Tower. After sliding the chinrest to the desired position, re-tighten the knobs.

- Set up the monitor and chinrest so that the chinrest is centered on the monitor and the monitor is horizontally aligned with the chinrest (**HINT:** measure from the left and right knobs on the chinrest to the left and right sides of the top of the display area of the monitor, these should be equal).
- Adjust the tilt of the monitor and height of the forehead rest. Ideally these should be set so that the top of the display is at about the same height as the forehead rest, and the display is tilted up slightly. The tilt can be changed if there are any reflection issues. Please follow "Section 8.4 Customizing Screen Settings" to update the tracker configuration.

**Continue to Chapter 8 "Testing the Host PC Installation"**

# 4. Desktop Mount / EyeLink Remote Installation

The Desktop Mount typically sits just below the Display monitor that the participant is looking at. When using the Desktop Mount, the EyeLink 1000 Plus eye tracker can be used as an ultra-high resolution head-supported system, and if the Remote Camera Upgrade is purchased, also as a remote/head-free-to-move eye tracker that requires no head stabilization. Please follow the steps below to set up the Desktop Mount.

## *4.1 Mounting the EyeLink 1000 Plus High-Speed Camera and Cabling*

The 1000 Plus Desktop Mounts can be configured to track eye movements up to 2000 Hz monocularly or 1000 Hz binocularly (with the 2000 Hz camera upgrade) with the head support, or 500 hz in the head-free Remote mode. Each operation mode works optimally with different camera lenses (see Table 1).

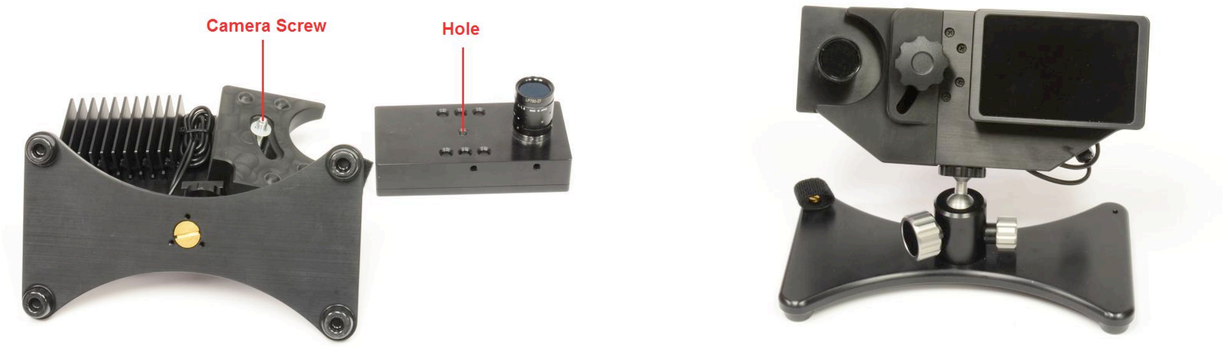


***Figure 4-1: Install Camera onto the Desktop Mount***

Follow the steps below to install the high-speed camera (see Figure 4-1):

1. Place the Desktop Mount on the table. Turn the recommended camera lens into the thread on the Camera. The 35 mm lens is recommended for the Desktop Mount monocular setup whereas the 16 mm lens should be exclusively used for the Remote tracking.
2. Hold the camera parallel to the table (and level with the top of the mount), align the hole on the camera to the camera screw on desktop mount, and then tighten the camera screw (see Figure 4-1). Dimples in the camera align with protrusions on the mount to ensure the camera is in the right position (the camera is parallel to the table).
3. After the camera is mounted onto the Desktop Mount, connect the two illuminator cables that come out of the Desktop mount to the right side of the EyeLink camera. Connect the camera power supply that was provided with your system to the power

connector on the right side of the camera (see Figure 4-2), and plug in the camera Ethernet cable.

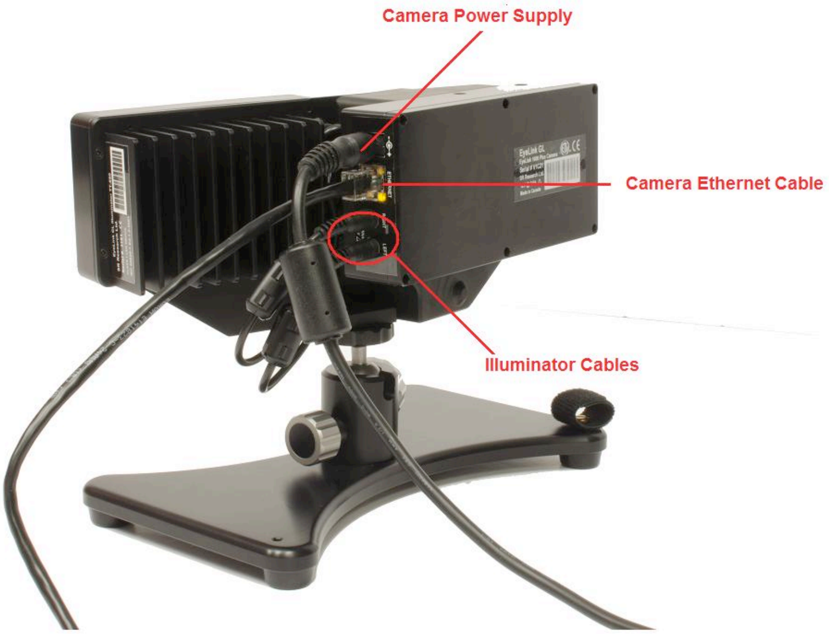


***Figure 4-2: Camera and Illuminator Cables from Desktop Mount***

### *4.2 Adjusting the Desktop Mount*

Follow the steps below to adjust the Desktop mount.

1) If you are using the chin rest supplied by SR Research Ltd., please check whether the table is suitable for mounting the chin rest – the table used should have a minimum thickness of 1.8 cm and a maximum thickness of 8.0 cm. Loosen the table clamp by turning the knob counterclockwise, place the table clamp fully onto the table, and then tighten it clockwise. Check that it is firmly secured by gently attempting to rock the table clamp base free. If the table clamp base wobbles, tighten it further. Next, place the forehead rest over the chinrest poles and tighten the knobs at the desired height.
2) The Display PC monitor should be set such that when the participants are seated and looking straight ahead, their eyes are level with 75% of the monitor height.
3) Check the eye-to-screen distance so that the maximum viewing angle of the display screen will be within 32-degrees horizontally and 25-degrees vertically. If you are using a large/wide-screen monitor, this means that there will be some gap between the camera and monitor.

4) The desktop mount should be placed at a distance of 40 to 70 cm from the observer (measured from the camera screw to the chinrest posts), with the illuminator and eye camera facing the participant. The ideal tracking distance is from about 50 to 55 cm.

5) For maximum eye tracking range, the top camera screw should be aligned to the center of the monitor. The Desktop Mount should also be raised so that the top of the camera and illuminator is as close as possible to the lower edge of the visible part of the monitor without blocking the subject's view.

6) Please check that the chinrest is horizontally centered with the monitor. Adjust the tilt of the monitor if there are any reflection issues.

7) **Please follow "Section 8.4 Customizing Screen Settings" to update tracker configuration.**

## *4.3 EyeLink Remote Hardware Adjustment for the Desktop Mount*

The default version of the EyeLink Remote uses the Desktop Mount and an EyeLink 1000 Plus Camera programmed for Remote viewing. Users who are exclusively interested in installing the EyeLink Remote should first follow installation instructions for the Desktop Mount, then continue below.

1) For the Remote mode, attach the 16 mm lens (shipped standard with a short adjustable focus arm or small wheel) to the high-speed camera.

2) The Display PC monitor should be set such that when the participants are seated and looking straight ahead, their eyes are level with 75% of the monitor height.

3) Ideally the Desktop Mount should be placed at a distance of about 60 cm from the subject's eyes. This means that if you are using a monitor smaller than 20", the Desktop Mount can be placed right in front of the monitor with no extra space between them. If you are using a larger monitor, it is necessary to move the monitor back while keeping the Desktop Mount at its optimal distance from the subject, so as to increase the distance between the subject and the screen while still ensuring that the eye tracker can track the subjects properly (the maximum viewing angle of the display should be within 32° horizontally and 25° vertically). In such cases, measure the distance (in millimeters) between the lens (at the point where the lens connects to the camera) to the display monitor and update the last screen of the "Screen Settings" configuration tool (see section 8.4 Customizing Screen Settings). This step is very important for proper head movement compensation when recording the eye position data in the remote mode.

4) The Camera Screw of the Desktop Mount should be aligned with the horizontal center of the monitor. For maximum eye tracking range, the Mount should be raised so that the top of the illuminator is parallel with, and as close as possible to, the lower edge of the visible part of the monitor without blocking the subject's view of the screen. To keep the

viewing distance relatively constant throughout a recording session, a comfortable, stable chair for the participant is recommended.

5) **Please follow "Section 8.4 Customizing Screen Settings" to update tracker configuration.**

**Continue to Chapter 8 "Testing the Host PC Installation"**

# 5. LCD Arm Mount Installation

Please follow the steps below to set up the EyeLink 1000 Plus LCD Arm Mount. Figure 5-1 illustrates a typical LCD Arm Mount setup and Figure 5-2 illustrates parts of the 1000 Plus LCD Arm Mount as it ships from SR Research under its standard configuration. The mount first requires fixing the Arm Base to a sturdy tabletop, assembling the LCD Arm components, attaching the EyeLink High-Speed Camera and then attaching cables. The following instructions detail each of these procedures.

The contents of Figure 5-2 in clockwise direction, starting at the top, are: the Camera and LCD Assembly, three Velcro strips (rolled and piled), cabling emerging from the end of the LCD Arm (which runs diagonally throughout the photo), the Arm Base, two L-shaped Imperial Allen wrenches, 2.5” and 6” extender tubes, the LCD Arm, and two angled brackets. Not shown in the photo are pieces of the monitor that allow it to be used with a traditional monitor mount should the user ever wish to remove it from the LCD Arm Mount for conventional use, the monitor driver CD and instruction booklet, and extension cables (SVGA, audio and power).

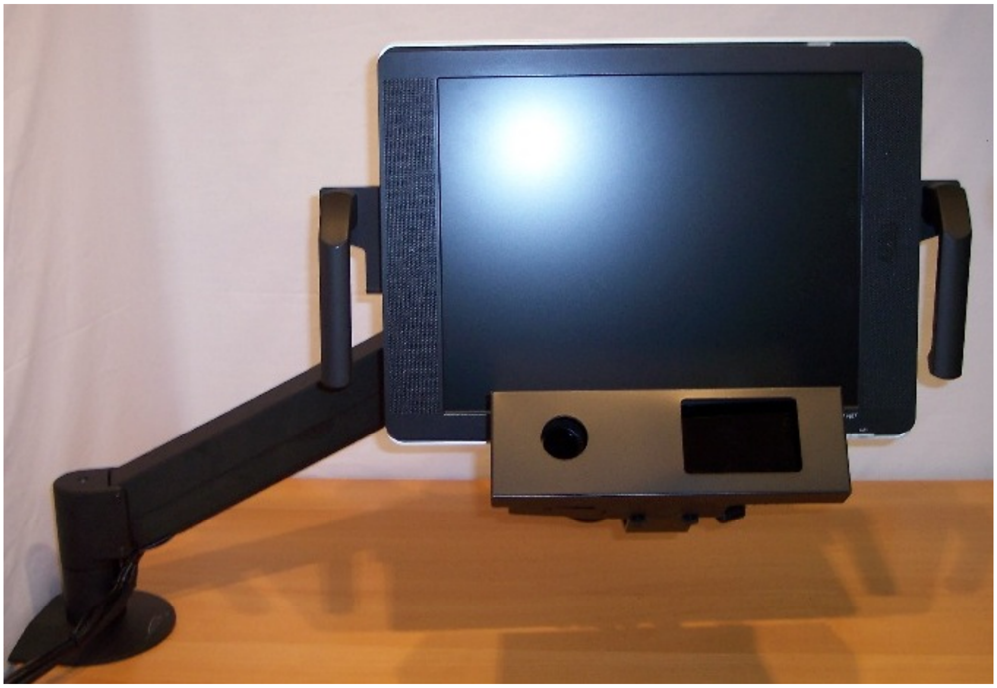


***Figure 5-1: Typical EyeLink 1000 Plus LCD Arm Mount Installation***

## *5.1 Choosing a Table*

Before mounting the LCD Arm, and the Camera and LCD Assembly, the Arm Base (see Figure 5-2 and Figure 5-3) must be affixed to a sturdy table. The Arm Base can accommodate tables with a thickness of up to 75 mm (7.5 cm, 2.95") at a depth of 18 mm to 65 mm (1.8-6.5 cm, 0.7-2.6"). The footprint of the Arm Base above the table is 160 mm wide × 140 mm deep (16 cm or 6 ¼" X 14 cm or 5 ½") and requires further clearance for the LCD Arm to swing in any direction.

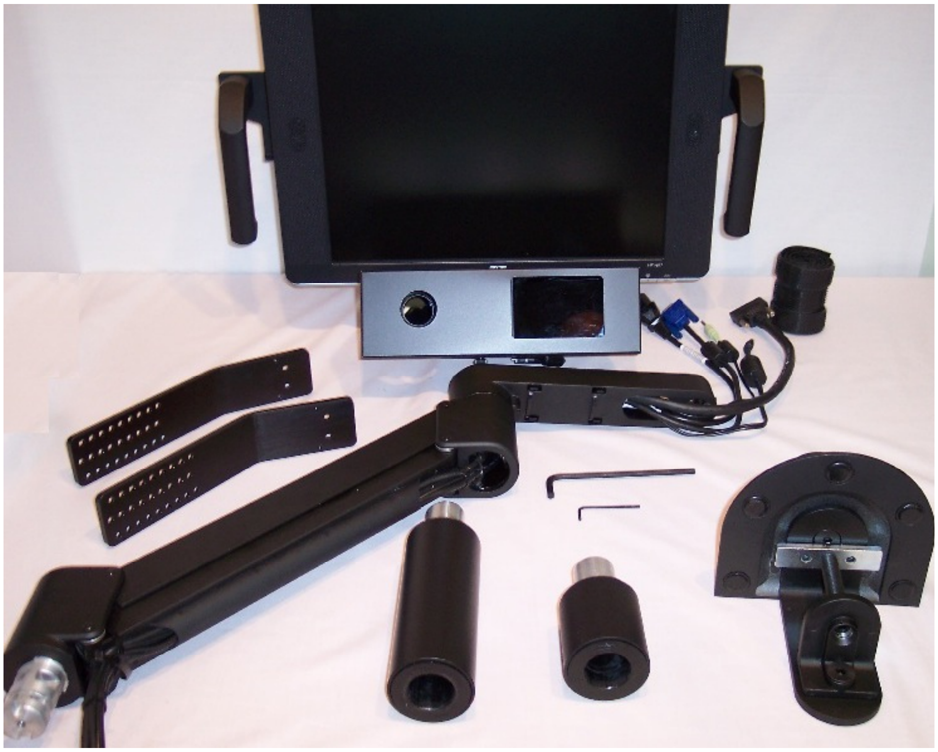


***Figure 5-2: 1000 Plus LCD Arm Mount Components: LCD Arm Mount Base, Arm, Camera and LCD Assembly***

The minimum depth for mounting on the table underside with which the system can work is an 18 mm ledge (in which case the maximum table thickness is 60 mm – 6 cm or 2 3/8").

The LCD Arm Mount can displace the Camera and Monitor Assembly from 11 cm below the surface level of the table to which it is mounted, to 23 cm above it. This places the bottom of the monitor from 2 cm below the table surface to 32 cm above it. Two LCD Arm extender units are shipped with the mount that can displace these measurements upwards by a further 6, 15 or together 21 cm (for a dynamic range of -11 to 44 cm, or considering the bottom of the display -2 cm to 53 cm). The LCD Arm can extend a distance of 75 cm from the base in any direction, with a minimal extension of 48 cm.

The desired viewing level of the participant should be combined with the above values when considering the table on which to mount the Arm Base. If the participant viewing- level is greatly below the tabletop surface then a lower table to mount the Arm Base may be required.

## *5.2 Affixing the Arm Base to a Tabletop*

There are two different configurations of the Arm Base, illustrated in Figure 5-3. On the left of Figure 5-3 is the configuration of the base for a table that can accept the shim at a deep position under its surface. This may be required if there is a lip at the table's edge, and is the default configuration that the system generally ships with. The bolt is fully tightened when the unit is shipped and places pressure against a shiny steel shim that abuts against the underside of the table.

**Be careful while handling the Arm Base's shim as it may have sharp edges around it centermost hole.**

The Arm Base configuration on the right of Figure 5-3 works with tables that have only a narrow ledge on the underside (as small as 18 mm, accommodating tabletop heights of 60 mm – 6 cm or 2 3/8"). This configuration is created by removing the long bolt that presses against the shim, loosening the screw at the bottom of the base, reorienting the L-shaped bracket so that the short portion is now perpendicular to the base, and screwing the bracket back to the base. The bolt must now be turned through the short portion of the L-shaped bracket in order to meet and apply pressure to the shim on the underside of the table. Some light viscosity oil may make the turning of the bolt go more smoothly, but keep in mind that oil will result in discoloration of the paint on the LCD Arm Turn the bolt through without using oil if possible.

To install the Arm Base, use the large supplied L-shaped Allen wrench to unscrew the black bolt that has a hexagonal opening in its end. It will have to be unscrewed enough to allow the shim perched on its end to fit under the table edge, as the shim will eventually be the point of contact between the bottom side of the Arm Base and the underside of the table. The large underside of the Arm Base will be the point of contact with the Table's top. Place the base in position, covering the biggest surface area of the table as possible and with the shim as deeply under the table as possible. With the center hole of the shim on top of the bolt, begin to tighten the bolt while holding the shim so that it does not fall off of the bolt. Pressure will eventually hold the shim in place. Tighten as securely as possible.

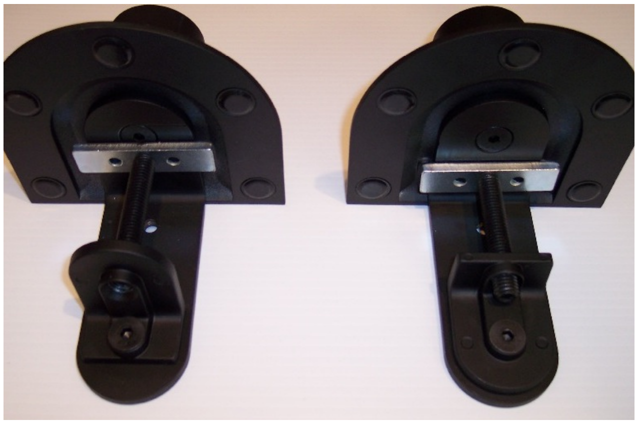


***Figure 5-3: Two Configurations of the LCD Arm Mount Base***

## *5.3 Assembling the LCD Arm Components*

Once the Arm Base has been secured to a sturdy tabletop, it is time to insert the LCD Arm into the Arm Base. At this point you may wish to add one or both of the Arm Extenders that were included with the system (2.5” and 6” extenders – 6 cm and 15 cm) as these raise the overall height of the LCD Arm Mount. Note that using an extender will also raise the lowest point that the LCD Arm Mount’s monitor can reach as they simply displace the entire unit vertically. The extender shaft simply fits into the silver cup of the Arm Base or into the cup of another extender.

Pick up the LCD Arm with one hand on each of the components to minimize its components from swinging. The round silver shaft at the bottom of the arm fits into the silver cup at the top of the Arm Base (or one of the optional extenders already inserted into the Arm Base) – simply lower the LCD Arm straight into the cup, with cabling off to the side of the base that is closest to the Display or Host PC to which the cabling will eventually be attached. Several pieces of double-side Velcro ship with the LCD Arm Mount in order to assist users who may wish to wrap the Velcro around the arm components to secure it before lifting. This can prevent the arm from swinging while it is being moved.

The EyeLink 1000 Plus LCD Arm Mount’s Camera and LCD Assembly holds an LCD computer monitor, the high-speed camera in the level position, and an infrared illuminator light source. These are affixed as a single unit that can be easily lifted using handles that are attached to each side of the LCD monitor. Facing the back of the monitor, grip the handles and guide the shaft of the tilter mechanism into the hole at the top end of the arm. Gently wiggle the assembly until the shaft is fully inserted into the arm.

**Some configurations of the LCD Arm may require weights at the end of the table opposite the Arm Base, to offset the LCD Arm’s weight.**

The LCD Arm is fairly heavy, with the entire apparatus weighing in at approximately 11 kg (or 25 lbs). Some possible configurations of the LCD Arm extend the monitor over empty space away from the table’s edge, placing the weight of the Camera and Monitor Assembly away from the support of the table. To prevent tipping, the table needs to be large, heavy and sturdy, or weighted at the end opposite from which the LCD Arm will extend. Caution should be used when first testing the range of the LCD Arm in case the table is not strong enough to properly distribute the weight of the apparatus. If the table begins to tip while extending the LCD Arm out into space away from the table, place the Arm apparatus back above the table surface and add weight (e.g., the Display computer?) to the table surface opposite where the Arm is extending. Repeat this procedure until it is clear that the apparatus is stable.

## 5.4 Mounting the EyeLink 1000 Plus High-Speed Camera

The EyeLink 1000 Plus LCD Arm Mount requires that the high-speed Camera be attached. It may have already shipped this way, or you may have to attach a camera that was part of a different mounting system.

To affix the EyeLink 1000 Plus camera, first remove the cover that obscures the camera and illuminator from the bottom front of the Camera and LCD Assembly. Two thumbscrews on the underside of the assembly hold the cover in place – simply loosen the thumbscrews and the cover will slide off in the forward direction. Mount the camera on the LCD assembly. On the front of the camera is a threaded hole that the camera screw from the LCD Arm Mount will go into. This will secure the camera. A knob is attached to the opposite side of the camera screw so that it is easy to turn the screw into the camera hole. If there is not enough room for the camera between the monitor and the camera assembly then more space can be gained by moving the assembly further from the monitor. Undo the hex bolts holding the bracket with the camera assembly to the monitor and move this forward (1 or 2 sets of holes) until there is enough room for the camera to slip in between the monitor and the camera assembly. Retighten the hex bolts and then proceed to attach the camera to the LCD assembly.

Dimples on the camera fit into protrusions on the mount in order to ensure the right positioning of the camera, which should be aligned level with the top surface of the part of the mount holding the camera screw. Tighten the knob until the camera is secured. Next replace the cover by sliding the slots on the cover's bottom around the thumbscrews on the underside of the assembly. Tighten the thumbscrews and adjust the cover so that it is minimally obscuring the IR illuminator and the camera.

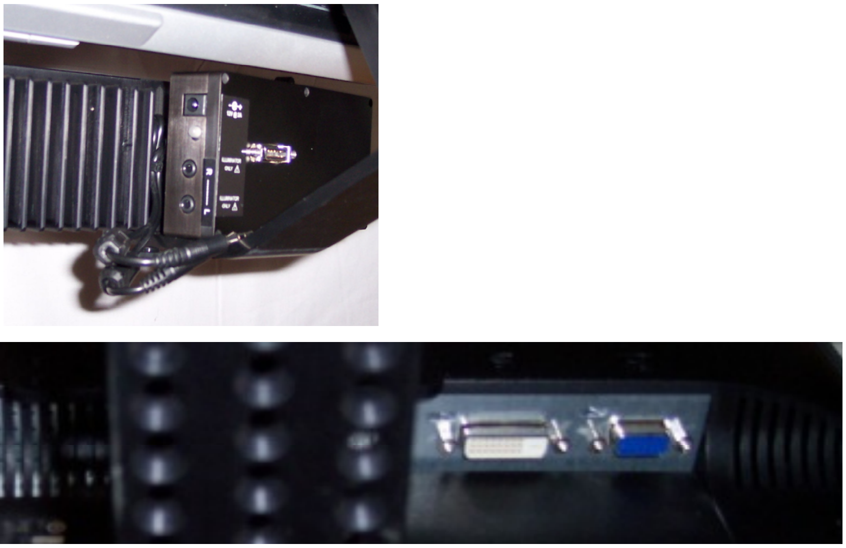


***Figure 5-4: Rearview of the LCD Arm Mount's Camera (top) and LCD Monitor (bottom)***

## 5.5 Attaching the Cables

Integrated into the LCD Arm Mount is the cabling required for the EyeLink 1000 Plus system and the computer monitor (camera and LCD monitor power cables, monitor audio cable, SVGA video cable, and the Ethernet cable). After assembling the LCD Arm Mount components, inserting the LCD Arm into the Arm Base, and attaching the camera, all of the cables need to be connected.

For all cables emerging from the LCD Arm, location descriptions assume a view of the Camera and LCD Assembly from the back underside of the monitor (see Figure 5-4, bottom). Guide the cables to the side of the camera and illuminator support bracket to which the cable will eventually be attached – this will prevent the cable from binding against the bracket when the LCD Arm is twisted in various directions. Follow these steps:

1. First, let's deal with cables attached to the high-speed camera (Figure 5-4 top).
    - Plug in the Camera Ethernet cable.
    - Insert the round EyeLink 1000 Plus power supply cable to the power connector on the right side of the camera.
    - Ensure that the two illuminator cables are plugged into the side of the high-speed camera – placement is not important. These cables are present on the Camera and LCD Assembly and do not emerge from the LCD Arm.
2. The remaining cables emerging from the LCD Arm connect to the LCD monitor as follows (Figure 5-4 bottom):
    - Insert the phono plug connector into the audio input jack on the bottom centre of the LCD monitor of the Camera and LCD Assembly.
    - Connect the SVGA cable to the SVGA input on the right of the LCD monitor. Tighten the screws by thumb or use a slotted screwdriver.
    - Connect the three-prong power cable into the LCD monitor power input on the left side of the monitor.

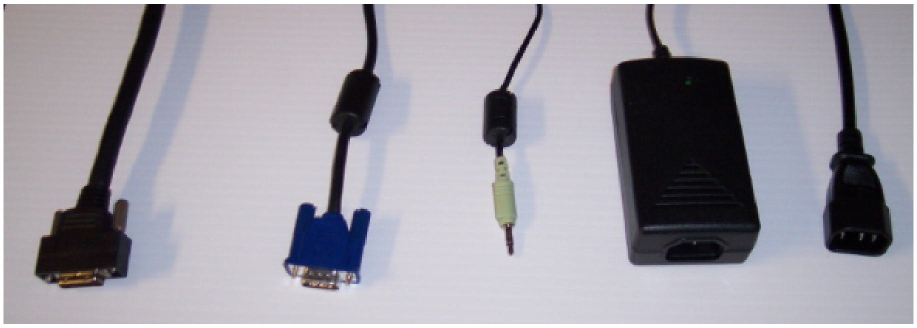


***Figure 5-5: Cables Emerging from the Bottom of the LCD Arm***

3. The following cables coming out of the bottom of the LCD Arm (shown left-to-right in Figure 5-5) are to be connected as described below. Extension cables are supplied as indicated in the text above. The first cable is the camera high-speed data cable and goes to the Host PC, the next two cables go to outputs on the Display PC, and the final two go to a power source.
    - If you are using a Workstation Host PC, connect the Ethernet cable to the network card on the computer labeled “Camera Ethernet”. If you are using a Laptop Host PC, use the Ethernet port on the motherboard.
    - Connect the supplied SVGA extension cable to the SVGA cable coming out of the bottom of the LCD Arm Mount. The female end of the cable coming from the LCD Arm attaches to a male connector on the extension. The extension’s female end attaches to the Display PC video card output port.
    - Connect the supplied audio cable extension (female end) to the 3.5 mm (1/8”) mini-plug on the audio cable emerging from the bottom of the LCD Arm. Insert the male end into the audio output jack on the Display PC.
    - Connect the supplied three-prong power cable (female end) to the camera power supply (male end) that is attached to a cable coming from the bottom of the LCD Arm. The male end plugs into a power source.
    - Connect the supplied three-prong power extension cable to the LCD monitor’s power input and plug the male end into a power source. The power supply in the monitor is 110/220 Hz so an adapter may be used (supplied) for countries outside of North America and Japan if the appropriate extension is not included.
4. One final cable needs to be attached. Connect the blue network cable to the port marked as “EyeLink Display Ethernet” on the Host Computer (or to the supplied USB Ethernet converter if you are using a laptop Host PC). Connect the other end of the Ethernet cable to the Ethernet port on the Display PC that you will later configure for use with the EyeLink system. Ensure the cable is securely connected at both ends.

## 5.6 Adjusting the Tension Points on the LCD Arm

Occasionally through use of the LCD Arm some of the joints or the hydraulics may require adjustment. Each joint can have the tension adjusted so as to require more or less force to move.

Tension adjustment points are indicated by hexagonal screws on the LCD Arm and can be adjusted using the Allen wrenches supplied. Recall that all hexagonal screws on the LCD Arm are in Imperial units. Loosening a joint (typically turning counterclockwise) too much may make it so that it does not stay in the desired position, so tighter tension (turning clockwise) is generally preferred.

## 5.7 LCD Arm Mount Adjustments for Monocular and Remote Recording

The 1000 Plus LCD Arm Mount can be used for highly accurate monocular recording with head stabilization (in which case the LCD Arm Mount is merely an alternative to the Desktop or Tower Mount options) or in Remote mode without head stabilization. In either case the 1000 Plus requires that some information about the physical setup be pre-configured in an initialization file, PHYSICAL.INI. Regardless of the mode of recording, Screen Settings setup for the LCD Arm Mount is identical to the Desktop Mount and is covered in “Section 8.4 Customizing Screen Settings”. Keep in mind when using the LCD Arm Mount however, that for highest accuracy, the viewing distance specified in Screen Settings configuration should be used with the LCD Arm Mount even though the LCD Arm may be dynamically adjusted on a per-user basis.

**LCD Arm Mount users should proceed to Chapter 8 “Testing the Host PC Installation”**

## 5.8 Disassembling and Transporting the LCD Arm Mount

The EyeLink 1000 Plus LCD Arm Mount ships with three 60 cm double-sided Velcro straps to aid in securing the Arm for lifting and disassembly. A recommended method of securing the LCD Arm using the Velcro straps is presented in Figure 5-6. It is recommended that two people participate in this task as the unit can be awkward to handle and does contain some delicate equipment.

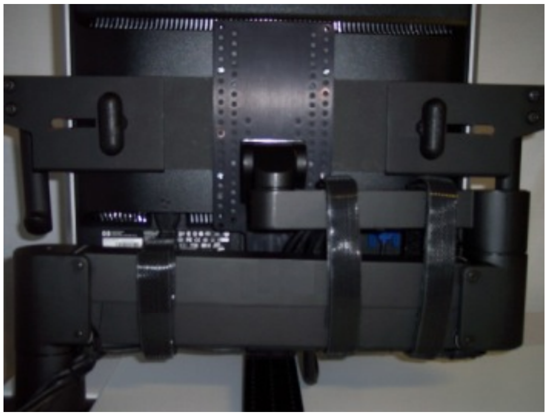


*Figure 5-6: Securing the LCD Arm for Disassembling and Transporting*

The weight of the LCD Arm with the Camera and LCD Assembly (approximately 11 kg, or 25 lbs) can cause shaft and cup holder points to become tight due to the pressures that the LCD Arm makes while moving the apparatus into various positions. Such pressures make what on assembly amounts to merely lowering a shaft into a cup holder not as easily reversed. On reversal the pieces need to be gently rocked back and forth to wiggle them free. As the LCD Arm is fully loaded this requires the rocking of large portions of the entire unit. To minimize the potential for damage, as many pieces as possible may be removed before attempting to remove the Camera and LCD Assembly from the LCD Arm, or the LCD Arm from the Arm Base. For instance, removing the camera cover and camera is advised.

**Important: It is recommended that two people participate in disassembling the LCD Arm Mount.**

**Read these instructions through and prepare a place to put the disassembled pieces before attempting disassembly.**

To disassemble the unit, one option is to lift the LCD Arm and Assembly together from the Arm Base. A second option is to remove the Camera and LCD Assembly from the LCD Arm first, and then to remove the LCD Arm itself from the Arm Base. In either case, double-sided Velcro strapping can assist in securing parts of the LCD Arm to make disassembly more manageable.

Once the LCD Arm has been removed from the Arm Base, removal of the Arm Base involves loosening the bolt from applying pressure to the shim until the Arm Base can slide freely off of the table. Be careful when handling the shim, as it may have sharp edges created around the center hole from the pressure applied to it.

### 5.8.1 Option 1: Remove LCD Arm and Camera Assembly as a Unit

First fold the LCD Arm as pictured in Figure 5-6. The Camera and LCD Assembly can be lowered so that the camera bracket is beneath the bottom limb of the LCD Arm. Raising it slightly can put pressure on the cable cover which may mark the cover, so some packing material may be inserted between these to prevent marking if desired.

Wrap Velcro (soft side against the LCD Arm is recommended) around the LCD Arm so that it will not extend when lifted (see Figure 5-6). Although full LCD Arm extension is prevented by the camera bracket pressing against the cable cover, the possibility exists for body parts to become pinched.

The entire LCD Arm, with intact Monitor Assembly, can now be lifted from the Arm Base. One person may need to apply downward pressure to the table while the other does the lifting, so that the table is not merely lifted off the floor. Some wiggling of the LCD Arm and its shaft may be required to make it come free from the Arm Base's holder cup. Once free the unit may feel top heavy, so be sure to have a strong grip. Gently lower the unit onto an awaiting soft foam surface, such as the inside of a hard shell case molded for transport and storage of the LCD Arm Mount.

### 5.8.2 Option 2: Remove Camera Assembly then Remove the LCD Arm

Fully extend the LCD Arm and ensure there is nothing preventing the upwards lifting of the Camera and LCD Assembly. One person will have to steady the LCD Arm and put downwards pressure on the top of the LCD Arm while the other person grabs onto the monitor handles and lifts upwards. Some rocking of the Monitor Assembly back and forth to dislodge it may be necessary.

Once free of the cup holder, the Camera and LCD Assembly can be placed on a hard surface with the bracket making contact with the table. At this point the LCD Arm can be removed from the Arm Base with one person applying downward pressure on the table while the other person lifts up on and wiggles the LCD Arm free of the Arm Base.

**Continue to Chapter 8 “Testing the Host PC Installation”**

# 6. Primate Mount Installation

The EyeLink 1000 Plus Primate Mount is a metal bracket that contains an illuminator for use with the EyeLink 1000 Plus camera. The camera is affixed to the top of the mount pointing downwards and the researcher supplies an apparatus that will reflect a view of the eyes up into the camera barrel while reflecting the infrared illumination onto the face of the subject being tracked (see Figure 6-1). Typically this would involve the researcher fixing a 'hot mirror' (a piece of glass that reflects infrared light while allowing other wavelengths to pass through it) in front of the subject's eyes. The subject can thereby see visual stimuli being shown by looking through the hot mirror, while the camera has a good view of the eyes. Typically the distance between the camera and where the eye would be for monocular recording would be identical to the Tower mount – 380 mm.

While the Primate Mount uses a similar set of metrics to the Tower Mount, it is intended to be flexible and ready to install in a wide range of situations where a means of head stabilization exists but the Tower or Desktop mounts are inappropriate. This frequently occurs when research on eye movements is being performed on primates with their head fixed, for instance by means of a Primate Chair. If the head is fixed extremely solidly, pupil only tracking may be possible. Otherwise, as with the other EyeLink 1000 Plus mounting options, Pupil-CR mode is recommended.

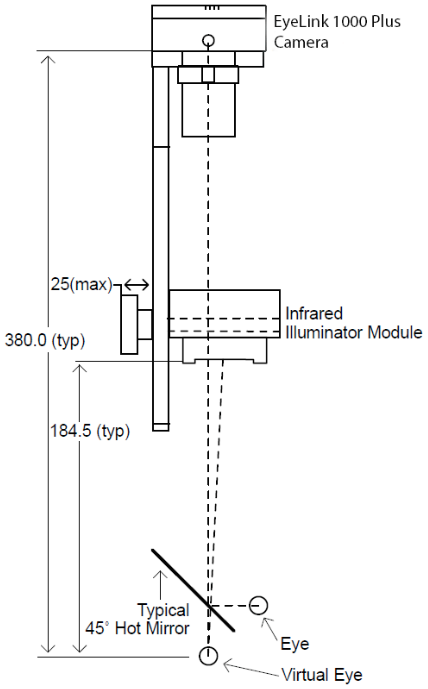


***Figure 6-1: Typical Primate Mount Installation***

## 6.1 Primate Mount Hardware Considerations

As experimental setups using this mount vary widely, following something akin to Figure 6-1 is recommended, but other configurations are possible. The configuration depicted assumes use of the 25 mm lens, but other lenses can be used for different viewing distances. As with the Tower mount, but not with the other systems, there is lots of room for movements of the hand in front of the body using the Primate Mount.

All system and optical components can be seen in the overall rear and side view drawings. The optical axis is represented in Figure 6-1 by the thin dotted line. The camera is placed above a 45° hot mirror which reflects IR light but is transparent to visible light. The reflection of the IR light provides an image of the eye to the camera. The subject views the stimulus source (such as a computer monitor) through the mirror. The illuminator module is mounted and angled so as to illuminate the eye via the mirror as well (the path from illuminator to eye is represented by the heavy broken line).

The illuminator should be angled to maximize illumination of the eye while minimizing bright spots and shadows on the face. For human subjects, this may require placing the illuminator to the temporal side of the tracked eye to reduce nose and forehead bright spots and shadows on the temporal side of the eye socket. The illuminator is normally located significantly closer to the eye than in the Tower mount (typically ~180mm from front of illuminator to eye). This distance results in an eye illumination level of ~1.0 mW/cm$^2$ at the eye (which is comfortable for extended viewing) with a reasonably-sized corneal reflection.

The EyeLink 1000 Plus illuminator bracket is designed to provide a rigid connection between the illuminator module and the camera. This is essential for pupil-CR difference tracking mode, as any motion of the illuminator relative to the camera will appear as eye rotation artifacts. This is also true to a lesser extent for the pupil-only eye tracking mode if the CR is positioned within the pupil itself. The camera attaches to the bracket with a clamp knob and 3 indexing bumps for positive alignment. The camera may also be attached to the bracket so that it is rotated by 180° to change the side of the bracket the lens is on. The illuminator block attaches to the bracket with a single clamp knob in a slot, allowing the distance from the illuminator to the eye to be changed to control brightness and CR reflection size, and allowing the illuminator to be rotated to maximize illumination. The LEDs used in the illuminator were selected for even illumination, so angling the illuminator is not critical.

The illuminator consists of an array of 24 infrared LEDs mounted in a heatsink block. The block also allows for a mounting of the assembly via an M8 thread in each side. It is important that the illuminator be mounted to a substantial piece of metal to help cool the illuminator as this will enhance light output. The IR LEDs emit at 910 nm, which was selected for reduced visibility in dark-adapted conditions compared to typical 890 nm LEDs. The LED array is safe for viewing by humans at any distance (it passes the IEC 60825-1 standards by a factor of 3) at any distance. However distances of >160mm from the eye (resulting in irradiance of <1.2mW/cm$^2$) are recommended for long-term viewing comfort.

The EyeLink 1000 Plus Camera mounts to the top of the bracket using a clamp knob (M8 thread) and a set of dimples on its front. This ensures that the camera cannot vibrate independently of the illuminator. The camera also has 5 mounting holes on its sides: 2 near the center of the camera's sides, and 3 aligned with the optical center of the lens and sensor. These holes take a standard 1/4”-20 screw (used on tripod and camera mounts). However, the hole at the lens end of the camera may not be robust enough to mount the camera with the illuminator bracket attached, especially if vibration is present.

It is recommended that the illuminator bracket be mounted to the head restraint assembly using the 3 holes supplied near the camera mount. The long side of the bracket should be oriented away from the subject to maximize head clearance. Once the bracket is mounted, the illuminator and camera may be attached and re-oriented as required. The camera may be installed with the lens on the left or right side of the bracket, and the illuminator fitted as required to place the connector on the side opposite the camera lens. The EyeLink configuration files may be modified to flip the camera image as required to match any mirrors or orientation of the camera.

While the camera will accept most C-mount lenses, the performance of most lenses is rather poor in infrared, with blurry or dark images resulting from lens coatings or non-optimal design. The standard camera configuration uses a 25 mm focal length lens, selected for high resolution and excellent IR performance. A similar 16 mm focal length lens is available which will allow the camera to function properly when closer to the eye.

As with other EyeLink 1000 Plus mounting options, the camera requires 12V power, and a supplied 60 mm (24”) cable is connected from the camera to power the illuminator module. A supplied ferrite choke on this cable must be on the end near the camera. Finally, a Cat6 Ethernet cable is connected from the side of the camera to the Ethernet port on the tracker Host PC.

To summarize the above points, when installing the primate system please keep the following points in mind:

- The camera should not be too close to the eye, as the pupil and corneal reflection must be contained within the tracking window.
- Bringing the illuminator closer to the eye will reduce noise but may cause discomfort and increase pupil erosion by the corneal reflection.
- Placing the illuminator too far from the eye will result in a dark image and noisy data.
- The line from the illuminator to the eye should be at least 10° off axis from the camera lens for proper imaging.
- The illuminator should be attached to a robust metal support, as should the camera. Preventing separate motion of the camera and illuminator due to vibration is critical to prevent extraneous noise in the data. The metal will also help to keep the illuminator cool, increasing its light output.

- While it is possible to rotate the camera by 90°, this will swap X and Y pupil position data. Contact SR Research for information about operating in this configuration.
- It is possible that an extra bright reflection may appear above the pupil in the eye image, as the illuminator may directly light the eye as well as through the mirror. A small baffle may be required to control this.

**Continue to Chapter 8 “Testing the Host PC Installation”**

# 7. Long Range Mount Installation

## 7.1 Description of the Components

The Long Range Mount consists of a Mounting Bar for the Camera Head and a focusable Long Range Illuminator (see Figure 7-1 left). In the figure, the Camera Head is on the left and the Long Range Illuminator is on the right, though these lateral positions are reversible. Both the Camera Head and the Long Range Illuminator are affixed to the Mounting Bar using circular clips that tighten onto the bar by turning a knob (see Figure 7-2). The Camera Head attaches to the Camera Head clip (which can be positioned at either a level or angled orientation), while the Long Range Illuminator attaches to an Illuminator Mounting Clip in a flexible manner so that the illumination can be adjusted vertically and horizontally to fit the tracking situation.

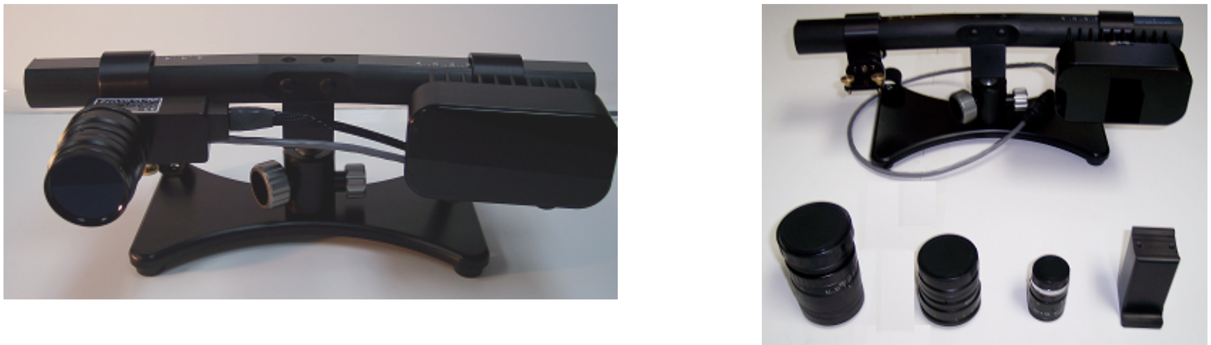


***Figure 7-1: EyeLink 1000 Plus Long Range Mount affixed to a Desktop Base (left) and pictured with a variety of lenses and Tripod Adapter (right)***

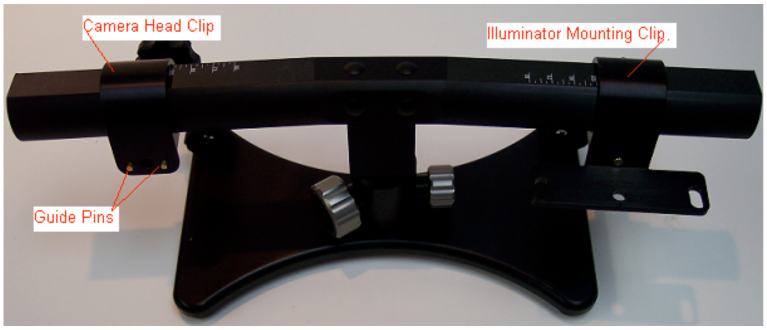


***Figure 7-2: Mounting Bar and Clips-note Guide Pins on the Camera Head clip (left)***

The Mounting Bar can be fixed one of several specially designed mounts (e.g., a Screen Mount for MEG or MRI, a customized MRI mount, the Desktop Base) or to a tripod (via a Tripod Adapter). The camera can be oriented parallel with the top of the Mounting Bar (the Level position) for monocular recording, or it can be rotated 45 degrees (the Angled position) for binocular (or monocular) recording. In addition to being tilted up or down, the Illuminator can be swiveled around its vertical axis to assist with positioning. Several lenses are available for optimal tracking at different eye-to-camera distances. Three lenses (75, 50 and 35 mm) and a tripod adapter are pictured (see Figure 7-1 right).

**The most important step in setting up the Long Range 1000 Plus is to align the illuminator so that it is maximally illuminating the camera's view. Doing this alignment ensures that no matter where the camera is pointed, it's target will be lit with infrared light provided there are no obstacles in the way.**

## *7.2 Overview of Setting the Mount*

The most important step in setting up the Long Range Mount is to align the illuminator so that it maximally illuminates the location that the camera is pointing. Once this is done, the Camera Head and Illuminator are tightened in place and the entire Mounting Bar can be easily positioned using the ball joint on the Mount to which it is affixed. Aligning the Camera Head and Illuminator ensures that no matter where the camera is pointed, its target will be lit with infrared light without requiring time-consuming adjustment of the components.

Loosening the knob on the back of the Illuminator clip allows lateral position on the Mounting Bar and tilt of the Illuminator to be adjusted. Loosening the knob holding the Illuminator to its clip allows the direction that the Illuminator is pointing to be changed. Loosening the knob on the Camera Head clip allows lateral positioning of the Camera Head by sliding it along the Mounting Bar, and allows the angle of the Camera Head to be rotated 45 degrees for binocular recording when an illuminated view of both eyes can be acquired.

The Long Range Mount is designed so that the side of the Illuminator and Camera Head are interchangeable. Cables coming from the Camera Head should be directed so they can exit and be securely fastened to avoid being crimped. Typically, the Camera Head and Illuminator are located at opposite ends of the Mounting Bar, and the cables will emerge from the center. However, some configuration require this heuristic to be violated (e.g., with the Siemen's 32 channel head coil – see below).

**For monocular recording, the typical lateral position for the Illuminator will be on the same side of the Mounting Bar as the eye-to-be-tracked.**

The most important factor in positioning the Camera Head and Illuminator is that there is an unobstructed line of sight from the camera to these components. For monocular recording, the typical position for the Illuminator will be more peripheral than the Camera Head, and on the same side of space as the eye-to-be-tracked. This ordering may not be necessary, but can help to directly illuminate the eye-to-be-tracked while cutting down on potential shadows. Given these recommendations, the configuration in Figure 7-1 depicts the ideal positioning for tracking a participant's right eye (left eye if viewed through a mirror as in many MRI setups) assuming that the camera has an unobstructed view past the head coil.

## 7.3 Securing the EyeLink 1000 Plus Fiber Optic Camera Head

The Fiber Optic Camera Head first attaches to a bracket that has several guide holes oriented at a right angle to the camera (rightmost image of Figure 7-3). The holes interface with guide pins on the Camera Head Clip (pictured at the left of Figure 7-2). The guide pins on the Camera Head Clip slide into guide holes on the Camera Head Bracket to determine the camera orientation. When the pins are in the center pair of holes the camera will be horizontally oriented and parallel with the Mounting Bar (the Camera Level position). When the holes are aligned diagonally with the guide pins, the camera will be oriented as required for binocular recording (the Camera Angled position).

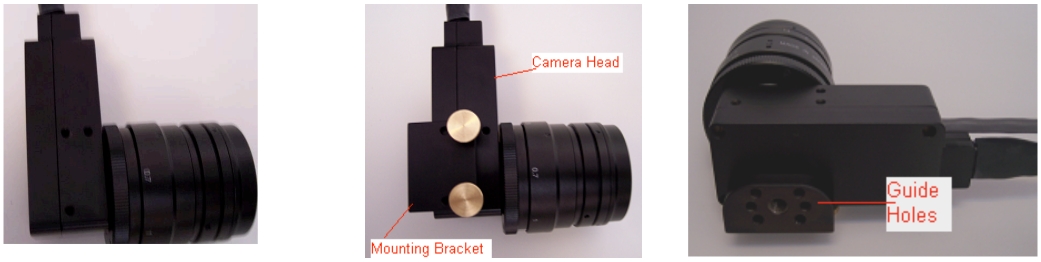


***Figure 7-3: Fiber Optic Camera Head with lens (left), attached to the Camera Head Bracket (center), Guide Holes in the Camera Head Bracket accept Guide Pins from Camera Head Clip (right)***

The top part of Figure 7-4 shows the Camera Head Bracket attached to the Mounting Bar without the Camera Head, in the horizontal or Level position for monocular recording (left) and Angled for binocular recording (right). The bottom of Figure 7-4 shows the Camera Head attached to the bracket and the bracket attached to the Camera Head Clip on the Mounting Bar.

With the lens cap on to avoid dirtying the lens, screw a 35, 50 or 75 mm camera lens into the threads on the Camera Head. See Table 1 of the current manual for recommendations on which lens to use for the eye-to-camera distance that you desire. In general, the larger the lens, the greater the magnification, and the longer the eye-to-camera distance that can be used.

**Attach the Camera Head so the fiber optic cable is emerging toward the center of the Mounting Bar. The Camera's image orientation can easily be changed in the Host PC application.**

To mount the Camera Head, first attach the Camera Head to the Camera Head Bracket as in Figure 7-3 (right) using supplied brass thumbscrews. Ideally, the cables should emerge from the side of the Camera Head providing the most protection from bumping or crimping as the fiber optics are a delicate part of the apparatus. There are two possible ways to attach the Camera Head given holes are present on the top or bottom, so attach using the side that allows the cables to emerge with the lowest possibility of being damaged.

Next align the holes on the Camera Head Bracket with the pins on the Mounting Bar's Camera Clip in either the Level or Angled position. Turn the knob on the back of the clip so that it threads into the Bracket. As the knob is tightened the Camera Head will become immobile at the position and orientation at which it is being held.

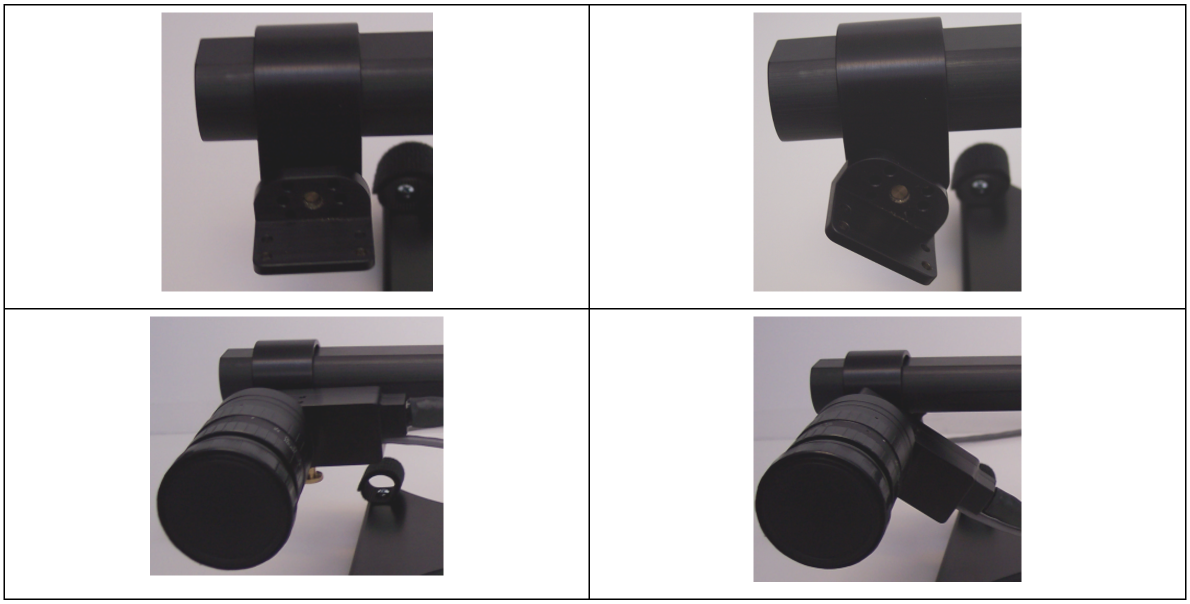


***Figure 7-4: Bracket in the Level Position (left) and Angled (right) – without the Camera Head (top) and with the Camera Head (bottom)***

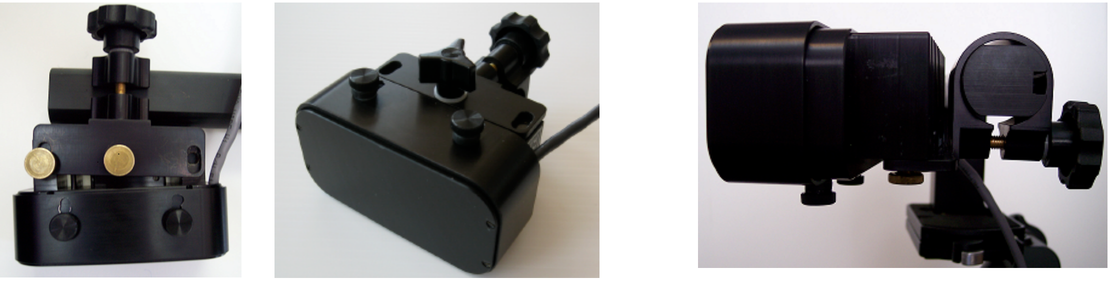


***Figure 7-5: Illuminator attached using two brass thumbscrews (left), or single thumbscrew (center), rotates around the Mounting Bar when its knob is released to adjust tilt (right)***

## 7.4 Securing the Illuminator

There are two different EyeLink 1000 Plus Long Range Mount Illuminators available, identified by a sticker on the side of the illuminator. The most common illuminator emits infrared light peaking at 890 nm. At this wavelength the infrared LEDs may be visible as there is some overlap with the human visible spectrum. A 940 nm Illuminator is also available that is for most purposes invisible to the subject (noticeable perhaps in only deeply dark-adapted states), even when in the darkened scanner environment. The tradeoff between these two illuminators lies in the 890 nm version being more intense and therefore more strongly illuminating at greater distances. Both illuminators however are sufficient for the 60-150 cm range of the Long Range 1000 Plus.

Affix the Illuminator to its Mounting Clip from underneath with its single black thumbscrew (center of Figure 7-5) or with two smaller brass thumbscrews (left image of Figure 7-5). Note, two smaller black thumbscrews hold the illuminator cover on – these are not involved in mounting the illuminator but will be used at a later step.

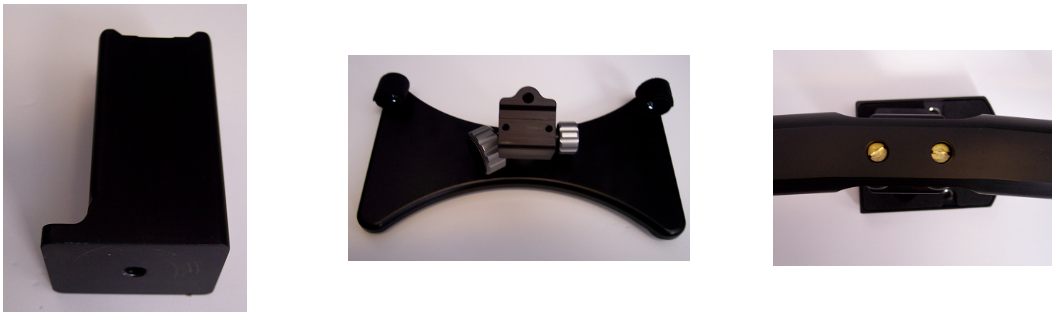


***Figure 7-6: Tripod Adapter (left), Desktop Base (middle) and Mounting Bar attached to the Tripod Adapter using Two Brass Bolts (right)***

## 7.5 Affixing the Mounting Bar

The Mounting Bar attaches to a Mount Base (e.g., Desktop Base, Screen Mount, specialized MRI Mount, Tripod Adapter, etc.) using two brass bolts (Figure 7-6, right) that are beneath small plastic covers. Simply pry the plastic covers free with fingernails to avoid scratching them or the Mounting Bar, and use a flathead /slotted screwdriver to affix the Mounting Bar.

If you have plans to use the Tripod Adapter, it has a ¼ inch, 20 threads-per-inch hole in the bottom (Figure 7-6, left) for use with standard tripods.

## 7.6 Cabling for Long Range System

This section describes the basic cabling components for the Long Range 1000 Plus. These components need to be integrated into whatever setting the eye tracker is going to be used in.

For an MRI Room the cabling for the system appears in Figure 7-7. For MEG or EEG, the wiring is similar but power typically passes through an open waveguide rather than going through any sort of patch panel.

Several possible methods for delivering the DC power connected to the Camera Head and Illuminator are available. These alternatives are outlined below and then separately described in more detail.

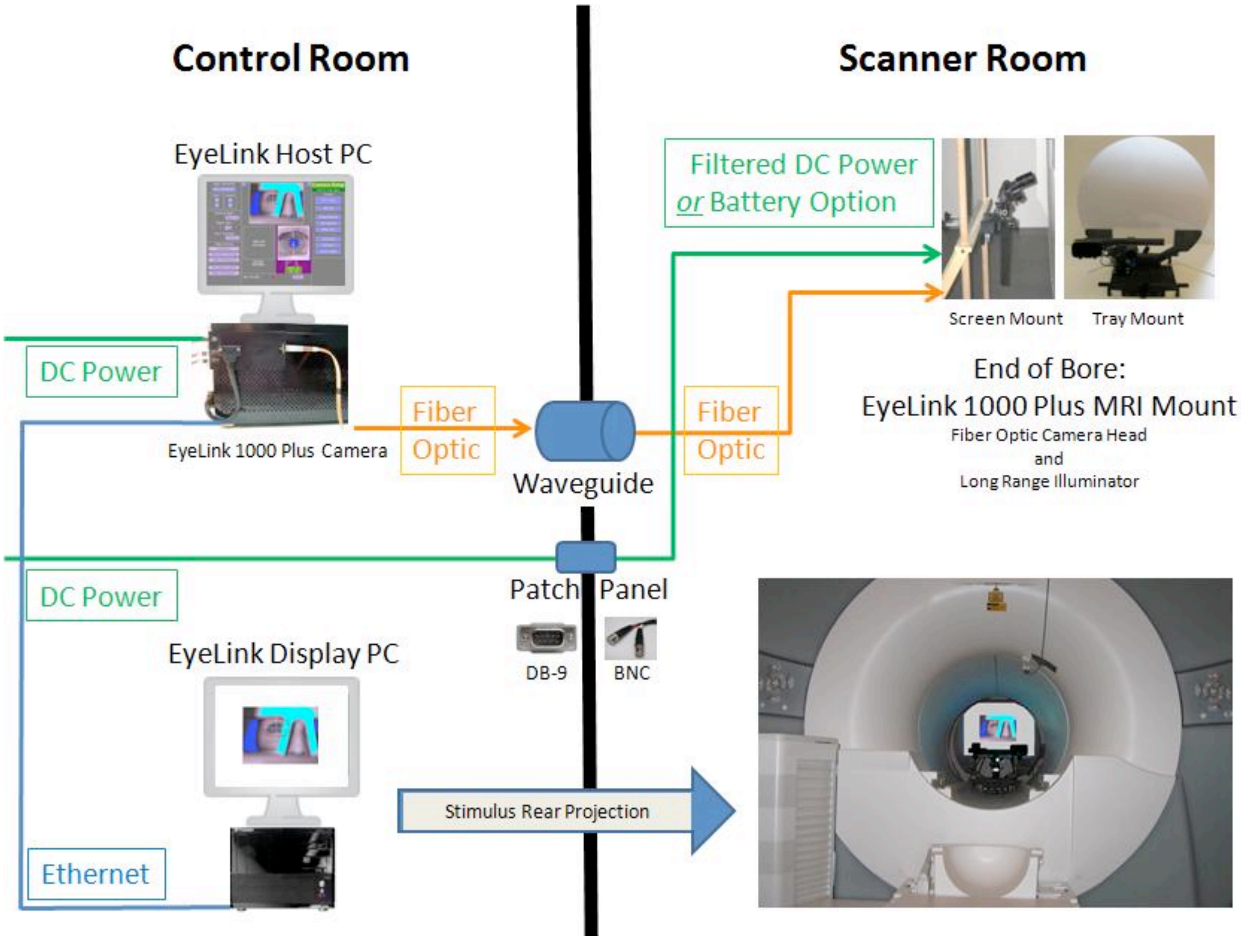

Control Room
Scanner Room
EyeLink Host PC
Filtered DC Power
or Battery Option
Screen Mount
Tray Mount
DC Power
End of Bore:
EyeLink 1000 Plus MRI Mount
Fiber Optic Camera Head
and
Long Range Illuminator
Fiber Optic
Waveguide
Fiber Optic
EyeLink 1000 Plus Camera
Patch Panel
DB-9
BNC
DC Power
EyeLink Display PC
Stimulus Rear Projection
Ethernet

***Figure 7-7: Typical MRI Components and Wiring Diagram- MEG/EEG setups are similar, though power is usually passed through a waveguide.***

**Fiber Optic Cabling**: If not already completed, connect the Camera Head's fiber optic cable to the supplied fiber optic extension cable. The other end of the fiber optic cable goes to the EyeLink 1000 Plus Camera which may be affixed to the back, left side of your Host PC using Velcro. Typically the fiber optic cable will pass through a waveguide from the room with the eye tracker to a control room where the EyeLink Host PC is situated. Ensure that the 12V EyeLink 1000 Plus power supply is connected to the power connector on the Eye EyeLink 1000 Plus Camera.

**Power Cabling:** There are several possible sources of DC power for the Long Range setup. All sources of power plug into the Camera Head and Illuminator using pressure-release LEMO connectors (pictured in Figure 7-8). The connectors can be unfastened by squeezing the connectors tightly at the positions where raised arrows appear in the rubber covering on either side of the connector, and firmly pulling the connectors apart.

1. **DB-9 Patch Panel Solution:** An AC power converter that connects via a 9 pin D-shaped, DB-9 (D-SUB) connector to a separate cable with pressure-release connectors.
2. **BNC Patch Panel Solution:** An AC power converter that connects using BNC connectors to a 9 pin D-shaped, DB-9 (D-SUB) connector to a separate cable with pressure-release connectors.
3. **Rechargeable Battery System:** A Battery Pack power system that is situated near the eye tracker and connects using a cable with pressure-release connectors.

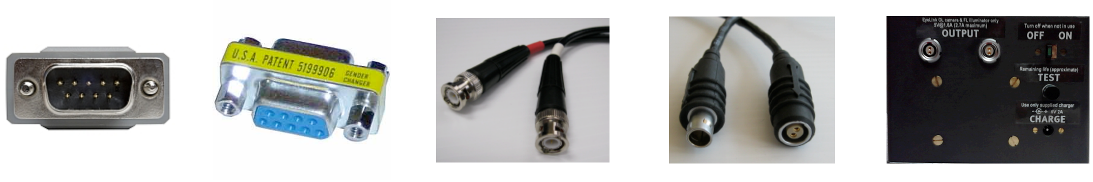


*Figure 7-8: Male DB-9 connector (left-to-right), gender changer with female connector showing, BNC connectors, LEMO connectors, and Battery System*

The first two power solutions listed above are designed to pass line-filtered DC power through a patch panel or filter plate into an RF-shielded room, such as an MRI room. For MEG or EEG setups, a waveguide is used to pass the power cable into the isolated room. Some shielding of this cable may be required if RF noise is detected.

**CAUTION: The DB-9 (D-SUB) connectors on the power cables are magnetic, including the cable that attaches inside the MRI scanner room. Exercise caution if carrying the cable into or around an MRI scanner, especially near the bore.**

**D-SUB Patch Panel Solution.** In the case of the first power cabling solution listed above, DB-9 (D-SUB) connectors (see two left images in Figure 7-8) are used on either side of the patch panel / filter plate. The AC converter should plug into the supplied RF line filter before connecting to the patch panel / filter plate in the control / utility room. Inside the scanner room, another DB-9 (D-SUB) cable connects power from the patch panel to the Camera Head and Illuminator. One or more gender changers may be required depending on the gender of the DB-9 (D-SUB) connectors available.

*Note that the DB-9 (D-SUB) connector contains ferromagnetic material and should be handled with caution when transporting the cable near an MRI scanner, or when connecting the cable to the patch panel inside the scanner room.*

**BNC Patch Panel Solution.** In the case of the second power cabling solution listed above, the power comes from the AC converter and plugs into a cable with red and white color-coded BNC lines (see third image from the left in Figure 7-8) that attach to the control / utility room side of the patch panel. Inside the scanner room, a second cable with two BNC plugs leads from the patch panel, terminating with a DB-9 (D-SUB) connector that attaches to a third cable with a DB-9 (D-SUB) connector on one end and LEMO connectors, to power the Camera Head and Illuminator, on the other.

*Note that the DB-9 (D-SUB) connectors contain ferromagnetic material and should be handled with caution near an MRI scanner. It is important that a solid connection between DB-9 (D-SUB) connectors exist between the second and third cables mentioned above. These cables should have their DB-9 (D-SUB) connectors bolted down before entering the scanner room, and use caution when carrying the cable in the scanner room.*

The BNC connectors of the cable coming from the AC power converter attach to the patch panel / filter plate BNC terminals of the control / utility room, and similar BNC connectors (of the joined second and third cables) attach to the BNC terminals on the filter plate inside the shielded room. It is CRITICAL that the colors of the BNC connectors match on either side of the patch panel / filter plate. That is, if the red-color coded connector plugs to a BNC terminal on one side of the plate it MUST connect to the red-coded connector of the cable on the other side of the plate. Failing to match these color codes will reverse positive and negative charges and will harm the eye tracker.

A pair of RF line filters (not supplied by SR Research) should be used on the control / utility room side of the patch panel between the BNC connectors supplying power and the BNC terminals on the patch panel. Excluding such line filters risks increasing RF noise transported into the scanner room via this cable connection.

**Rechargeable Battery System.** The third power solution listed above is the simplest and provides the lowest potential for RF noise, while allowing for fewer cables in the room. It involves using power provided by two 6V, 13 Ah lead-acid rechargeable battery units (see rightmost image of Figure 7-8) located near the Camera Head and Illuminator. A simple cable with LEMO pressure-release connectors on either end connects the battery output to the Camera Head and Illuminator.

Some notes on using the Rechargeable Battery System:

- Pressing a TEST button on the front of the battery's faceplate will light up an indicator on the top of the battery, showing a conservative estimate of how many hours of eye tracker usage remain given the battery's charge. If more than two hours charge remains the indicator light is green, while it is red once the charge gets down to this critical level.

- Each battery should last 6-8 hours after a full charge (depending on battery age and how the battery was cycled during its life). Charging takes about 9-12 hours from dead with the supplied 2A charger (which simply plugs into the front of the battery), and considerably less time if the battery is only partially discharged.
- It does not harm the battery to leave it plugged into a power source for long periods of time, and for longest battery life:
    - batteries should remain fully charged if possible
    - the power switch on the battery pack should always be turned OFF when not in use, otherwise the battery pack will self-discharge
    - batteries should be charged and stored above the 3 hour charge level
- The battery is a BB Battery 6V, 13 Ah lead-acid battery, but the connector on it is proprietary, so please contact SR Research for replacements, as not all after-market batteries will have the appropriate connector or dimensions to fit in the battery case.

## *7.7 Configuring the Long Range Camera Hardware*

Follow these steps to configure the system for Long Range tracking. The intent is that these steps need only be completed once to use the Camera and Illuminator in a given configuration. Multiple subjects can be run under identical conditions (e.g., tracking the right eye at a particular distance) requiring only minor focusing or positioning from subject to subject.

This section provides a general overview of the steps involved to configure all uses of the Long Range 1000 Plus including ANY mount for MEG or MRI. Readers interested in a more specific solution for particular MEG or MRI hardware may wish to skip ahead to Section 7.8 for MEG or Section 7.9 for MRI.

**The Long Range Camera Hardware needs to be configured once per setting.** After initial configuring, multiple subjects can be run under identical conditions (e.g., tracking the right eye) with only minor focusing from subject to subject.

### *7.7.1 Acquire Preliminary Measurements*

Upon first installing the Long Range 1000 Plus, two important distances need to be known– the eye-to-camera distance (ETCD), and the distance from the eye to the top and bottom of the visual display. These lengths include the entire optical path that light will travel from to reach the observer, so include any distances involving mirrors.

The ETCD (eye-to-camera distance) is measured from where the lens meets the Camera Head to the bridge of the participant's nose, in centimeters. For difficult environments, consider measuring the length of a piece of string that has been held in the position of the optical path.

Measurements from the eye to the top and bottom of the visual display are used in computations expressed in terms of degrees of visual angle. Be sure to measure the distance from the eye to the screen top and bottom, as well as the length and width of the projected image. This time the measurement is in millimeters. Use these values to follow “Section 8.4 Customizing Screen Settings” to modify the PHYSICAL.INI file settings on your Host PC.

### 7.7.2 Assemble the Long Range Mount Components

1) *Position the Camera Head and Illuminator.* If there are no obstructions in the line of sight from the Camera Head or Illuminator to the eye-to-be-tracked then the side of the Mounting Bar for these items is not critically important, though having the Illuminator on the same side as the tracked eye (Camera Head more centrally located) may result in better illumination for monocular tracking.

   Decide on the side of the Mounting Bar to place the Camera Head and Illuminator and slip them into position, ensuring the cabling for the Camera Head is emerging toward the interior of the Mounting Bar. The Camera Head may need to be reattached to the Camera Head bracket at a different vertical orientation to ensure the cabling emerges toward the interior, thereby protecting it from getting bumped. Vertical orientation can be easily changed by removing the Camera Head from its bracket and simply reattaching it to the bracket upside-down, before tightening it to the Camera Head clip.

   For binocular recording, the Camera Head bracket needs to be tightened to the Camera Head clip at a 45 degree angle. To angle the Camera Head, undo the thumbscrew of the Camera Head Clip and align the holes on the Camera Head Bracket with the guide pins on the bracket (see Section 7.3 for detailed steps).

2) *Determine which lens is most appropriate.* Based on the eye-to-camera distance, use the Lens Guide (Table 1) to determine the most appropriate lens. Screw the small end of the lens into the threaded Camera Head.

3) *Check the Camera Head and Illuminator Separation.* The further away the mount is from the eye, the greater the ideal separation of the Camera Head and Illuminator. On the top of the mount are numerically marked distance scales that indicate the appropriate locations on the Mounting Bar for the inner edges of the Camera Head and Illuminator, based on different eye-to-camera distances measured in cm. Loosen the knobs holding the Camera Head and Illuminator Clips to the Mounting Bar, adjust the clip positions so the inner edges align with the appropriate distance and then tighten the knobs.

4) *Focus the Illuminator.* The illuminator has a lens on it that will focus the infrared light at different distances. Without removing the black thumbscrews (circled in Figure 7-9 left) on the underside of the illuminator – loosen them so that the illuminator cover will slide back and forth to reveal an illuminator distance scale. Sliding the cover forward will reveal markings on the scale from 60 cm at the closest eye-to-camera distance to 150 cm at the furthest (see sticker in Figure 7-9 right). Adjust the cover so that its edge aligns with the marking that approximates your eye-to-camera distance and then tighten the black thumbscrews.

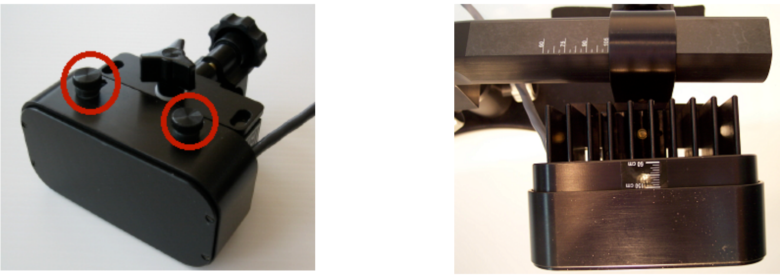


*Figure 7-9: Focusing the Illuminator*

**The following steps ensure proper illumination of whatever the camera points at. This is done by aiming and securing the Illuminator so that the halo it produces is in the center of the camera's view. Because the Camera Head and Illuminator will move together, whatever is viewed will be well-lit.**

**A Target Screen appears at the end of this chapter. Place the Target Screen at the distance of the eye-to-camera distance and once alignment is complete, move the mount into its final location.**

### 7.7.3 Align the Camera Head and Illuminator

5) *Check Host Software Configuration.* Start the EyeLink Host PC application and click "Set Options" button. Check that the "Configuration" is set to "Long Range Mount (Monocular)" or "Long Range Mount (Monoc/Binoc)" corresponding to how you oriented the Camera Head (Level or Angled respectively for monocular and binocular recording). Then navigate to the "Camera Setup" screen.

   The next steps are often more easily accomplished if you have a large view of what the camera is registering. The 1000 Plus API has the ability to transfer the global view of the camera to the Display PC and all of the demo programs installed with the EyeLink Developer's Kit are capable of achieving this step (e.g., TRACK.EXE on Windows or GCWindow.app on MacOS). After running one of the SR Research demo programs, transfer the global camera image. For more details on this step, novice users may wish to consult the tutorial of the 1000 Plus User Manual.

6) *Focus the Camera and Roughly Focus the Lens.* As humans do not see infrared, monitoring the output of the infrared camera is necessary. In this step, we will shine the Illuminator at a Target Screen (or even a wall) at the distance where the participant's eye(s) will eventually be and ensure that the camera's view is centered within the bounds of the illuminated area. The Target Screen appears at the end of this chapter.

   Start by placing the mount at the eye-to-camera distance from the Target Screen or a wall. With a good view of the camera's global image on the Host or Display PC, point the Camera Head at the Target Screen's center (e.g., Figure 7-9). While watching the global image, turn the lens so that the image becomes clearer – it does not have to be perfectly focused at this stage and may look something like either image of Figure 7-9.

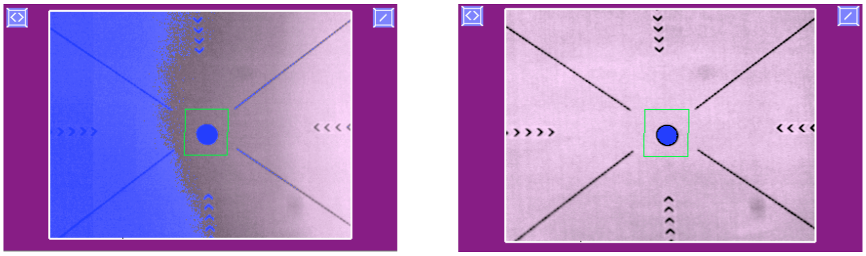


***Figure 7-10: Pointing the Camera – a visible illumination boundary indicating poor lighting of the left portion of the camera's view (left) and a fully illuminated target indicating intense and uniform illumination (right)***

7) *Align the Illuminator and Camera.* The boundaries of the illumination will show with distinctly different threshold coloring in the illuminated versus non-illuminated locations. The amount of threshold coloring displayed on the global view can be adjusted up or down by pressing the UP and DOWN arrow keys on either the Host or Display PC keyboards. You can also toggle the threshold coloring on and off using the "Threshold Coloring" button on the Host PC's Camera Setup screen.

   The left side of Figure 7-10 illustrates the boundary of illumination in the global camera view – the illuminator would need to be shifted (in this case, leftwards), so that the entire target is illuminated as in the right side of Figure 7-10.

   Adjust the horizontal and vertical placement of the Illumninator as follows:

   - While monitoring the global camera view, adjust the illuminator's tilt up and down by rotating the clip around the Mounting Bar so that the Target Screen is brightly illuminated and the bulk of the illumination appears in the center of the Target Screen on the vertical – tighten the knob holding the illuminator to the Mounting Bar to secure the position. The brightly illuminated region will be grayscale, while the region in the infrared dark will be threshold colored.
   - By swiveling the illuminator around the thumbscrew, adjust the angle of the illuminator on the horizontal plane so that the entire Target Screen is intensely and uniformly illuminated.

### 7.7.4 Put the Mount into Position and Find the Eye

8) *Place the Mount at the intended distance and position.* For eye tracking purposes, the mount should be within 25 degrees of visual angle from the top of the area to be

tracked, without blocking the subject's view of the bottom part of the display. An unoccluded line of sight for the subject, from the eye to both illuminator and Camera Head is crucial for optimal eye tracking.

9) *Check the Orientation of the Camera Image.* If the camera image is vertically flipped, this can be corrected by pressing the button to the right of the global camera view on the Host PC. If the camera image is horizontally flipped, this can be corrected by pressing the button on the left to rotate the camera image 180° and then click on the vertical flip button.

**Recommendation: Turn USE SEARCH LIMITS off and ONLY have one eye in the camera's view.**

**The 1000 Plus has the ability to track the eye no matter where it falls in the camera's view. This is highly desirable when the eye is difficult to locate (i.e., at long distances!) and use of SEARCH LIMITS restricts the area that the eye will automatically be detected within.**

10) *Select the Eye to Track and Adjust Thresholds.* Press the 'A' key for autothreshold, or in the global camera view move the mouse cursor on top of the pupil position and click the left mouse button (on either the Host or Display PC). The camera image for the eye should now be displayed in the zoomed thumbnail view. If the pupil is detected, a green box and crosshairs will also be drawn.

    Use the left or right cursor key to select the zoomed camera view. Adjust the camera focus by turning the focusing ring of the lens. You may do the adjustment from the side opposite to the illuminator to prevent the camera image or the illumination to the eye from being blocked by your reach. Look closely at the eye image on the zoomed view while turning the focusing ring until the eye image is clear. If a colored circle (CR signal) appears near the pupil, the best focus will minimize the size of this circle.

The system is now ready to test. Please see the tutorial in the User Manual, though you may wish to skim the contents of Chapter 8 first.

## 7.8 Installation in a MEG Room

The EyeLink 1000 Plus Long Range mount is non-ferromagnetically optimized, made mostly of plastic, aluminum and brass. The Fiber Optic Camera and Long Range Illuminator minimize electrical noise and attach to the Mounting Bar using brass thumbscrews, plastic clips and aluminum brackets. All of these features, coupled with excellent shielding, make the system ideal for the MEG environment.

The Camera Head, Illuminator and Mount are located inside the MEG room. The system is powered with DC power entering the room through a waveguide along with a fiber optic cable, or with a rechargeable battery system contained within the room to eliminate the need for cables to enter. Typically an AC power supply is located outside the room and plugged into an isolated source as even this inexpensive solution produces low noise. The Host PC too is situated outside of the MEG room, though the camera images can be transferred and projected into the room via an application running on the Display PC, making camera setup easily accomplished. As the only connection between the room and the Host PC is fiber optic, no other isolated power outlets are required.

The eye tracker can be easily removed from the MEG room when not in use, for either space conservation reasons or to use it in a behavioural lab. Apart from requiring a Host PC in the vicinity, setup and take down are fast with only minimal adjustment required between subjects. Once configured, simply place the eye tracker in the room as appropriate when eye tracking is desired, plug in its two DC power leads and its single fiber optic lead, power up the system and begin recording.

There are three mounting options that have proven useful for MEG at the current time:

1. *Desktop Base.* The Mounting Bar can be attached to a Desktop Base such as in Figure 7-1. To get a good view of the eye, the base is typically placed on a shelf bridging the space above the participant's lap. This allows the eye tracker to be at about 60 cm from the observer with CTF and Elekta Neuromag MEG systems, making for an excellent eye-tracking signal.

   Once the mounting position has been determined, users may wish to create a wooden pedestal to rest the mount on. It is important that the mount be solid, as any vibration will degrade eye movement recording and act as a potential noise source. For this reason the Desktop Base should never be placed on any construction making contact with the participant or their chair in order to prevent the subject from introducing any form of vibration to the apparatus.

2. *Screen Mount.* A Screen Mount is designed to clamp to the bottom of a screen frame such as that supplied with Elekta Neuromag systems (see left side of Figure 7-11) or often used with 4D systems (see right side of Figure 7-11 for an example of such a custom-built screen). The top of the mount has the universal ball joint found on the 1000 Plus Desktop Base of Figure 7-1.

3. The Screen Mount typically clamps onto the bottom of a screen frame. Mounts are available for narrow (37 mm width) or wide (75 mm) screen frames. An optional rubber bumper takes up a further 9 mm of this gap. The bottom of the Camera Head and Illuminator are a minimum of 150 mm above where the clamp mounts onto the screen with a maximum height of 395 mm.

**When using the Screen Mount with MEG, ensure that the eye tracker remains centrally positioned in front of the subject, otherwise a portion of the screen (i.e., a bottom corner of the projected area) will become difficult to track if it is located outside of the camera's view. Floor**

**guides marking centered screen positions are recommended.**

Some sites have used the screen mount attached to other surfaces such as a shelf or even a tripod to hold the eye tracker, rather than using the Desktop Base.

4. *Tripod.* The Mounting Bar can be removed and attached to a MEG-friendly tripod (not supplied) using the plastic Tripod Adapter, and the tripod placed at the participant's feet in front of, or just below a projection screen. The tripod is used to adjust the view of the camera by moving the illuminator and camera head together. Typical viewing distances for such a setup are longer as the tripod must be far removed from the subject.

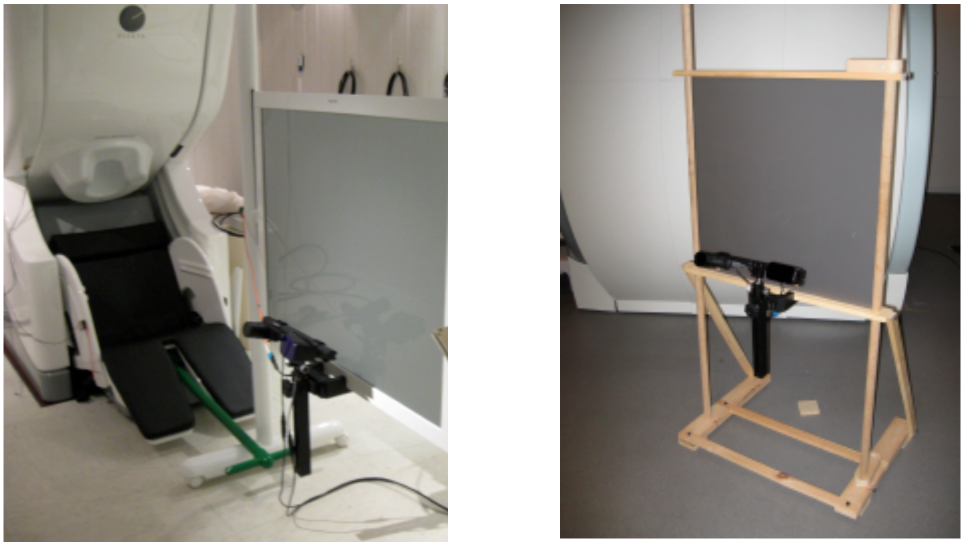


***Figure 7-11: Screen Mount used in conjunction with the Elekta Neuromag screen (left) and a custom-built wood-frame screen (right)***

## 7.9 MRI Installation

**Before beginning installation in an MRI environment, please be sure to familiarize yourself with the earlier portions of this chapter. This section is essentially duplicating Section 7.7 but with specific mention of the MRI environment, mounts, common head coils and components.**

Installation in MRI settings will vary as different sites often have unique solutions for presenting visual stimuli. Placement of the screen, the head coil type and other site-specific factors must be considered in positioning of the eye tracker. Please refer to Figure 7-7 for a diagram of the component placement and wiring within an MRI environment. Only the Screen Mount and Tray Mount are shown in Figure 7-7 but other mounts are similarly positioned.

The Fiber Optic Camera and Long Range Illuminator are designed to operate at the opening of the bore or even in the bore where appropriate mounts exist. Typically, it is desirable to position the Mounting Bar with the Camera Head and Illuminator directly below the visual display. This will use some potential space at the bottom of the visible display area, but both Camera Head and Illuminator need to be visible to the participant. Infrared reflecting first-surface mirrors on the head coil optimize the eye-tracking signal, with mirrors for several models of head coil available from SR Research.

A list of tested configurations appears in Table 3-5, along with comments about positioning the mount. Where binocular recording has been achieved, it is noted as 'possible' in Table 4 and 5 because it relies on the ability to view both eyes simultaneously in the angled camera view, which may be dependent on the stimulus display, the lens required and other site-specific physical factors that may vary between installations.

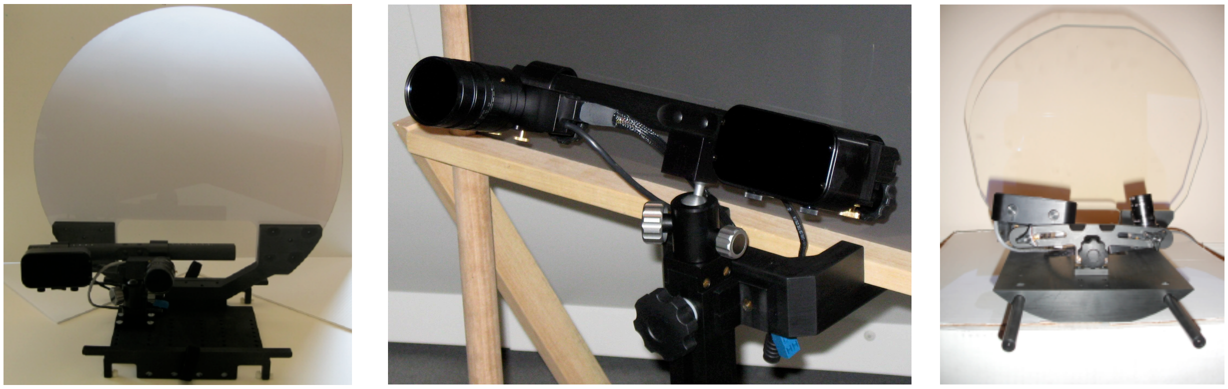


***Figure 7-12: Tray Mount with optional screen for Siemens Trio (left), Screen Mount (middle), and the mirrored mount for the Siemens Allegra head-only scanner (right)***

### *7.9.1 Determine the Mount and Configuration to Use*

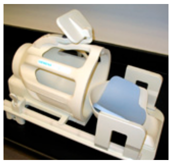
After wiring and positioning the components according to Figure 7-7, the first step in setting up the fiber optic system for use will be determining the mount and head coil to use, deciding whether binocular tracking is required or desirable, and configuring the Mounting Bar appropriately. Several mounting options and camera positions for different MRI systems, head coil and display/screen configurations are possible.

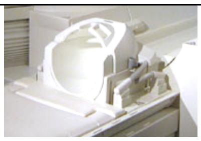
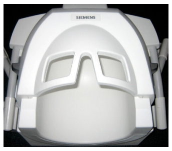
To date, EyeLink 1000 Plus Long Range Mounts have been installed in at least the scanner configurations listed in Table 3. Other configurations may be possible and other scanners and configurations have been successfully tested. These are not listed here as we have not yet designed specialized mounts for them or they may not be popular models. Customers should feel free to inquire to support@sr-research.com about systems not listed.

| **Scanner** | **Mount** | **Head Coil(s)** |
|---|---|---|
| Siemens Full Body (e.g., Trio) | Tray Mount | 8 (birdcage), 12, 20, 32* channel |
| | Screen Mount | 12, 20, 32* channel |
| | Desktop Base | 12, 20, 32* channel |
| Siemens Head Only (e.g., Allegra) | Allegra Mount | 8 channel (birdcage)* |
| Philips Achieva | Screen Mount | 8*, 20, 32 channel |
| | Desktop Base | 8*, 20, 32 channel |

* monocular tracking only

***Table 3. Some Installed Configurations***

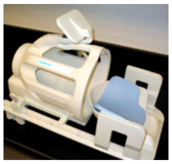
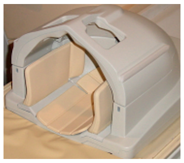
| **Mount** | **Head Coil** | **Binocular** | **Mount Positions** |
|---|---|---|---|
| Tray Mount (with optional in-bore screen)<br>**OR**<br>Screen Mount<br>**OR**<br>Desktop Base | 8 Channel 'birdcage'<br> | Possible | End of Bore<br>-illuminator and camera centered |
| | 8 Channel Siemens*<br> | Unlikely –head coil top casts shadow | End of Bore<br>-illuminator and camera off to one side, or centered if elevated |
| | 12 Channel Siemens<br> | Possible | End of Bore<br>-illuminator and camera centered or off to one side |
| | 20 Channel Siemens<br>(32 channel bottom) | Possible | End of Bore<br>-illuminator and camera centered or off to one side |

| | | | |
|---|---|---|---|
| |  | | |
| | 32 Channel Siemens<br> | No | End of Bore<br>-illuminator and camera on same side of mounting bar, with illumination located as peripherally as possible |

* currently there is no replacement first surface mirror available for this head coil

***Table 4. Siemen's Head coils and mount positions***

The mounts are pictured in Figure 7-12 with the Tray Mount for the Siemens Trio pictured on the left, configured for use with the 32 channel head coil (see also Figure 7-13 left and top). The Screen Mount attached to a custom-built screen is pictured in the middle image of Figure 7-12, and the mirror mount for the Siemens Allegra small bore, head-only mount appears in the rightmost image. The Desktop Base is pictured in Figure 7-1.

| Mount | Head Coil | Binocular | Mount Positions |
|---|---|---|---|
| Screen Mount<br>**OR**<br>Desktop Base | 8 Channel Philips*<br> | Unlikely –head coil top casts shadow | End of Bore<br>-illuminator and camera off to one side, or centered if elevated |
| | 32 Channel Philips<br> | Possible | End of Bore<br>-illuminator and camera centered |

* currently there is no replacement first surface mirror available for this head coil

***Table 5. Philip's Head coils and mount positions***

The next subsections discuss positioning the Camera Head with the different MRI mounts. You may consult the section for your particular mount, and then continue to Section 7.9.2 to mount the Camera Head and Illuminator onto the Mounting Bar, and the Mounting Bar onto the mount.

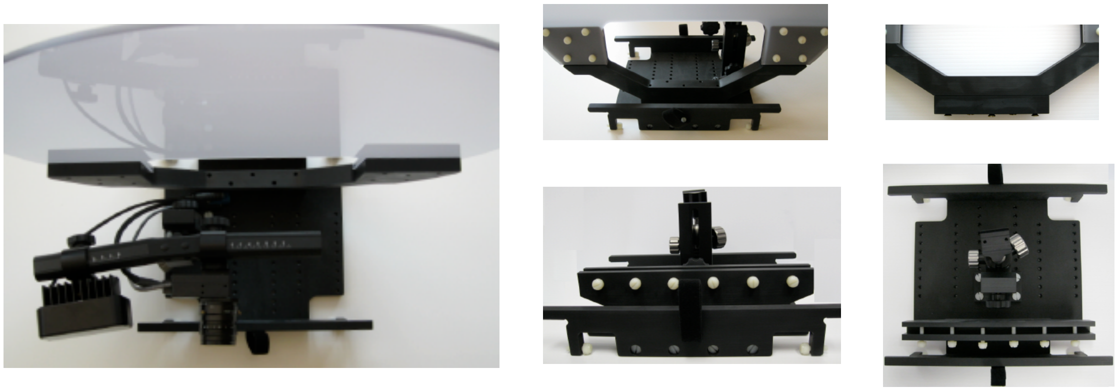


***Figure 7-13: Tray Mount for Siemens family of scanners pictured from above with optional screen (left), from behind with screen (top-middle) and configured for user-supplied screen (bottom-middle), riser block on screen (top-right) and from above (bottom-right)***

#### *7.9.1.1 Tray Mount (Siemens Full Body Scanners)*

The Tray Mount was designed to be inserted into the end of the bore and to be held in place against the bedrails using nylon bolts at the bottom of the mount. The mount, pictured in the left side of Figure 7-12 and throughout Figure 7-13, has a post which holds the Mounting Bar on an adjustable ball head. The post is attached to the tray's bottom using four nylon bolts and can be flexibly positioned at multiple viewing points in the center of the tray (bottom images of Figure 7-13), or off to one side or the other (left and top-middle images of Figure 7-13) for difficult tracking environments. Similarly, the height at which the Mounting Bar is positioned can be adjusted, and two different length posts are included for added flexibility in the range of heights at which the Mounting Bar can be positioned.

The Tray Mount has an optional high quality projection screen that is attached at the end of the tray using nylon or brass bolts. It also comes in a configuration to hold a screen supplied by the user (bottom images of Figure 7-13). For larger bore openings there is a rectangular riser block that raises the screen higher by a couple of centimeters. If this is too high for your bore then remove this riser block (see top right image of Figure 7-13). There are two different lengths of bolts for use with or without the riser block.

The Tray Mount slides into the end of the bore where its feet rest on the bedrails. Four nylon bolts attached to the feet should be turned to put pressure on the bedrails and wedge the mount securely into place. Although the Tray Mount was designed to be operated from the end of the bore, it is possible to slide it deeper into the bore in the direction of the head coil. Deeper positioning may work without introducing problems for MRI imaging, however eddy currents from the magnetic field will introduce greater vibrations in the eye movement recordings. For this reason it is recommended to position the Tray Mount at the end of the bore.

The Tray Mount has a hole cut out beneath the screen so that the operator can reach in to adjust the position of the Mounting Bar and focus the lens. It is expected that during Camera

Setup and calibration, the image from the camera will be projected onto the screen (either the optional Tray Mount screen or the screen provided by the user) so that the effects of the operator's adjustments can be monitored.

For binocular recording, the post holding the Mounting Bar should be centered as pictured in the bottom right images of Figure 7-13.

***Use with the Siemen's 32 Channel Head Coil***. For use with the 32 channel Siemens head coil (monocular only) the post needs to be displaced to the side of the eye-to-be-tracked. The mounts in the left image in Figure 7-12 and also Figure 7-13 left and top are all configured for tracking a subject's right eye if used with the 32 channel Siemen's head coil.

Note that placement of the illuminator is as peripheral as possible and that the Camera Head is as far toward the center of the Mounting Bar as possible. This may shift the placement of these components from the recommend positions on the scale, but they remain separated and importantly, have a more lateral view of the eye through the mask of the head coil. It is feasible that both the Illuminator and Camera Head be placed on the same side of the Mounting Bar to make the camera view slightly more peripheral.

To optimize the eye tracking the subject's head should be elevated as high as possible without touching the mask of the head coil. For optimal brain imaging, ensure that the head remains centered in the head coil – padding one side of the head so it is held more laterally will result in better eye tracking but may produce inferior brain images.

#### *7.9.1.2 Screen Mount (all scanner types)*

The Screen Mount is designed to clamp to the bottom of a user-supplied screen that is situated outside and at the end of the bore. Once clamped onto the bottom of the screen frame, the height of a ball head holding the Mounting Bar can be adjusted to provide the optimal view of the eye in the head coil mirror. Loosening the knob of the Screen Mount allows the component holding the Mounting bar to slide up and down. The optimal Mounting Bar position from an eye-tracking stance is as high in the field of view as possible, without blocking the bottom of the display.

There are two Screen Mount configurations. The mounts are available for narrow (37 mm width) or wide (75 mm) screen frames. An optional rubber bumper takes up a further 9 mm of this gap. The bottom of the Camera Head and Illuminator are a minimum of 150 mm above where the clamp mounts onto the screen with a maximum height of 395 mm.

For binocular recording the Screen Mount, and hence the Mounting Bar, should be centered at the end of the bore. For use with head coils that provide visual obstacles when viewed directly from behind (e.g., the 32 channel Siemens head) the eye tracker will need to be displaced to the side of the eye-to-be-tracked. Ideally, the surface area of the projection screen should be much larger than is required so that even with the Screen Mount attached to the center of the screen, the screen can be slid to the side (moving the eye monitor off to the side with it) while still allowing the entre display projection to land on the screen surface. This makes for easy positioning of the eye tracker with the ability to switch between the eye-to-be-tracked monocularly (such as with the Siemens 32 channel head coil) by simply moving the screen. The alternative is to loosen the mount holding the eye tracker to the screen and physically move its position beneath the screen.

#### *7.9.1.3 Desktop Base (all scanner types)*

The Desktop Base is simply a modified version of the Desktop Mount's ball joint base, made without ferromagnetic materials. It provides a quick and easy way to hold the Mounting Bar in position for fast setup of the eye tracker. The drawback is that it may not be as easy to keep in position between subjects as the more specialized mounts that are also fixed in position.

Though other mounts may be preferable as they are customized to particular scanner environments, the Desktop Base is often useful as it can be used in the MRI environment and is very amenable to testing different eye tracking configurations. Simply position the Desktop Base with the Mounting Bar attached outside the bore on top of something sturdy with no ferromagnetic content – such as a stool or table from within the MRI room.

For binocular recording the Desktop Base and Mounting Bar should be centered at the end of the bore. For use with head coils that provide visual obstacles when viewed directly from behind (e.g., the 32 channel Siemens head), the Desktop Base needs to be as far over to the side as possible with the Mounting Bar tilted on an angle so that neither the Camera Head nor Illuminator are blocked by the bore. The same principles apply as with the regular mounts – if the subject has a clear line of sight to the Illuminator and the Camera Head then tracking is possible.

#### *7.9.1.4 Short Bore Mount (Siemen's Allegra)*

A special mount has been created for short bore scanners such as the Siemen's Allegra that goes into the bore. The Camera Head and Illuminator are seated on the bottom of the bore pointed straight up at a "hot mirror". The hot mirror reflects infrared light while passing light in the visible spectrum, thereby allowing the subject a clear view out the back of the bore. The hot mirror reflects the image of the eye from the head coil mirror to the Camera Head while also reflecting the infrared from the Illuminator to light up the eye.

Given the limited space in the bore there is really only one place for the mount, though the Camera Head and Illuminator, mounted on a dowel, can have their angle adjusted.

The Allegra Mount supports monocular eye tracking only.

### *7.9.2 Mounting the Camera Head and Illuminator*

After determining the mount to use, it is time to begin assembling the components. Based on the mount, head coil and whether or not to track binocularly, decide which side of the Mounting Bar to place the Camera Head on, and which side to place the Illuminator. The general considerations below apply to any mount or MRI eye tracking environment.

**For most purposes, placing the Camera Head on the left side of the mounting bar when viewed from behind (right side when viewed looking into the camera is a good position to start with. This has the camera centrally viewing the eye(s) and the illumination off to the side.**

Depending upon your tracking situation, there are a few considerations in optimal placement of these components:

- The Camera Head always needs an unobstructed line-of-sight view to the eye(s) to be tracked.
- Which eye will be tracked – the dominant eye? Left or right? Having the Camera Head on the same side as the eye-to-be-tracked may allow one to avoid obstructions.
- Is binocular tracking required? For binocular tracking a more centered camera view is desirable.
- Illuminator placement does not have to be perfect as long as there are no obstructions causing a shadow to be cast across the eye(s) to be tracked.

The Camera Head and Illuminator can be positioned on either side of the Mounting Bar, but a peripheral illumination source is likely to be desirable so that the camera can have a view of the eye that is as perpendicular as possible. Having a view of both eyes will enable binocular recording, or the easy ability to switch between recording left or right eye, something that may not be possible when the Camera Head is more peripherally placed.

Having said this, there may be situations (e.g., the Siemens 32 channel head coil, or the 8 channel head coil used with the Siemen's, Philips and General Electric Scanners) where more peripheral placement of the Camera Head (hence central placement of the Illuminator, and monocular-only recording) is necessary. For instance if the head coil is blocking the Camera Head's view when it is centrally positioned, then moving the Camera Head more laterally may be necessary to acquire an unobstructed view. In such cases the eye-to-be-tracked will most likely remain the same across all subjects to prevent having to reconfigure the mount on a subject-by-subject basis, as this can be a more time consuming (5-10 minute) procedure.

After determining which side to place the Camera Head and Illuminator, slide these components onto the Mounting Bar, but do not yet tighten them into place.

A second consideration regarding the Camera Head is whether it needs to be level (for monocular tracking) or angled (for binocular tracking). See Section 7.3 for detailed steps regarding angling the Camera Head for binocular recording.

### *7.9.3 The Head Coil Mirror*

The Head Coil Mirror signal needs to be clear and stable for a good eye tracking signal. A first-surface mirror with good infrared reflecting properties is desirable. The default mirrors provided by head coil manufacturers is typically not a first-surface mirror, resulting in extra reflections which can interfere with the image of the pupil and CR, and typically reduces illumination. This reduces the accuracy of the eye tracker.

SR Research strives to make available good-quality first-surface mirrors (with the silver reflective coating on the front surface rather than the back surface, and with a high infrared transmitting coating) for popular MRI systems. Use of such a mirror yields an improved image signal and cuts down on the number of extra refraction artifacts that can pollute the camera image. If building your own head coil mirror, try to ensure that a first-surface mirror is used.

Put the desired mirror on the head coil. The goal is to align the illuminator and camera with the mirror so that reflected infrared from the illuminator lights up the eye-to-be-tracked while the mirror reflects the image of the eye, back to the camera. To achieve this, direct line-of-sight from the camera and illuminator via the head coil mirror is required.

#### *7.9.3.1 Replacement First Surface Head Coil Mirrors*

SR Research is currently working to replace the standard mirrors on popular systems. Due to time-consuming and labor-intensive manufacture of these mirrors we cannot easily custom-make mirrors. If your site uses a custom mirror that has a wider range of tilt and a larger field of view than manufacturer-supplied head coil mirrors, you may wish to look into obtaining a front-surface mirror with good infrared reflecting properties. The only head coil pictured in Table 4 for which SR Research cannot currently supply a front surface replacement mirror is the 8 channel head coil sometimes used with Siemens scanners and frequently used with the Philips Achieva.

#### *7.9.3.2 Minimizing Head Coil Mirror Vibration*

First surface replacement mirrors typically affix to the head coil in an identical way to the manufacturer supplied mirrors. It is important that the mirror vibrate as little as possible in order to minimize the vibration of the stimulus display experienced by the subject and to minimize movement of the eye image in the mirror from sources other than the eye itself. Sometimes using thick tape where the mirror assembly contacts the head coil can result in a tighter connection between the mirror assembly and the head coil as well as dampening the vibration. Alternatively Velcro may help to secure the mirror in position and assist in damping vibration.

Minimizing vibration of the head coil itself is important as this will in turn reduce vibration of the mirror.

### *7.9.4 Measuring and Using the Eye-to-Camera Distance*

Before putting the eye tracker in position, measure the distance between the camera and the head coil mirror as well as the mirror to the eye. The sum of these distances is the **eye-to-camera distance (ETCD)** and will be used as discussed in Section 7.7 to:

1. Select the lens to use

The ETCD is used to select whether to use a 35 mm, 50 mm or 75 mm lens. These operate at viewing distances of 50-90 cm, 90-120 cm and 100-150 cm respectively (see Table 1). Affix the appropriate lens to the Camera Head by turning the threaded lens into the Camera Head.

2. Set the lateral position of the Camera Head and Illuminator on the Mounting Bar. Use the ETCD to set the separation between the Camera Head and Illuminator, by aligning the edge of the Camera Head and Illuminator clips with the ETCD value marked on the Mounting Bar scales. For more details see item number 1) in Section 7.7.2.
3. Focus the Illuminator by setting the edge of the Illuminator cover to the ETCD as marked on the scale on the Illuminator's top. For more details see item number 4) in Section 7.7.2.
4. Align the Iluminator to maximally light where the Camera Head is pointed as detailed in Section 7.7.3.

While measuring distances, also be sure to measure the eye to screen top and bottom, as well as the width and height of the projected image. This time the measurement is in millimeters. Use these values to follow "Section 8.4 Customizing Screen Settings" and to modify the PHYSICAL.INI file settings on your Host PC.

### 7.9.5 Align the Camera Head and Illuminator

Follow the instructions from Section 7.7.3 to align the Camera Head and the Illuminator so that no matter where the camera is pointing it is well lit. Having performed the alignment outside of the bore, put the eye tracker into position.

For an alternative approach to aligning the Camera Head and Illuminator with the mount in place, see the following section.

### 7.9.6 Put a Volunteer/Confederate in the Scanner and Find the Eye(s)

To aid in the fine positioning of the camera and illuminator, have the Display PC projecting the global image of the camera as you finely adjust the camera and illuminator position by moving the Mounting Bar. Be sure it is the global image that is being projected as this will show the entire range of the camera and make it easier to get the camera's field of view to include the eye.

At this point, it will be easiest to have a volunteer in the bore with the head coil and head coil mirror in place, as though ready to be scanned. The volunteer should be able to report line of sight to both the Illuminator and the Camera Head when the mirror is tilted at an angle yielding a good view of the entire area where the stimulus is to be displayed.

Adjust the focus of the lens by turning the lens barrel to roughly focus the lens so that at least what you are looking at is clear. Use any landmarks of the head coil (such as writing) to orient your pointing of the camera; having the volunteer make recognizable movements such as winking might help. The threshold coloring of the Host computer may assist in finding the eye, but keep in mind that if you would rather see the image uncolored, you can turn the coloring off and on by toggling the “Threshold Coloring” button of the Camera Setup screen.

Adjust the Mounting Bar of the eye tracker to change the Camera Head’s view. The eye needs to be clearly visible in the camera’s global view and ideally, not too close to the edges of the camera’s view. If operating in monocular mode, be sure only one eye is present in the global image. When the system is capable of tracking the eye, crosshairs will appear on the pupil and corneal reflection indicating that the system is capable of picking up the eye.

If the observer can clearly see the infrared points of the illuminator (890 nm - the 940 nm Illuminator may be invisible) as well as having line of sight down the barrel of the lens, then the camera and illuminator are close to the correct position. Have the volunteer report on how the camera should be adjusted to achieve their ability in seeing down the camera barrel. Note that this is an alternative method to aligning the Camera Head and Illuminator – after finding the eye in the center of the global camera image, adjust the illuminator angle so that the eye(s) and its(their) surround are well lit.

### *7.9.7 Adjust Image Thresholds and Focus the Lens*

This section assumes some familiarity with the basics of using the 1000 Plus. For a thorough introduction to a tracking session, please consult the tutorial in Section 3 of the 1000 Plus User Manual. Some of the essential steps are recapped here, but for an overview of the procedure and the reasoning behind the different steps, please consult the tutorial.

Once the eye is in view of the camera and the crosshairs are present, with threshold coloring turned on, switch to the zoomed in thumbnail view of the eye. The thumbnail that is selected and transferred to the Display PC can be toggled by pressing the left or right arrow/cursor keys on either keyboard.

Focus the lens. The goal is to minimize the size of the corneal reflection, resulting a good focus overall. Simply turn the barrel of the lens while monitoring the size of the corneal reflection to minimize it. If threshold coloring is preventing a clear view of the eye, try ‘A’ for autothreshold to set the thresholds in reasonable range.

Once the image is in focus, press ‘A’ on the Host or Display PC keyboard to perform an ‘autothreshold’ or use the mouse to click on the pupil of the eye, which will typically perform an autothreshold procedure. Autothreshold simply guesses at some appropriate threshold levels to use in determining which parts of the image belong to the pupil and the corneal reflection. Pupil threshold levels should be above 60 (presented below the thumbnail image) otherwise this indicates that the illumination is not good. Below a level of about 60 will produce noisy sample data even if the system is able to track the eye. The corneal reflection threshold is rather robust at most threshold settings, but typically optimal recordings can be achieved by reducing the threshold slightly to completely fill out the coloring of the corneal reflection.

If you are running the TRACK.EXE program as recommended, press C to begin the camera setup, calibration and validation steps. Refer to the tutorial of Section 3 of the User Manual for more information about performing the calibration and validation under normal behavioral laboratory situations.

## *7.10 Calibration and Drift Correcting with the Long Range System*

There are a number of operational differences between the 1000 Plus between use in the behavioral laboratory and in environments where the Long Range amount is typically installed. The first of these issues has to do with configuring custom calibration layouts so that odd-shaped spatial areas can be calibrated. A second issue has to do with whether and how to employ drift correction in conjunction with the 1000 Plus and the Long Range Mount.

### *7.10.1 Calibrating Atypical Spatial Areas*

#### *7.10.1.1 Customized Calibration Target Positions*

Given the confines of an MRI scanner and different screen and head coil configurations, the standard calibration of the entire screen area may not always be appropriate. For instance, if a display projection eliminates the ability of the subject to view the corners of the display (e.g., so that the bottom part of the display can use more of the bore's area to present the stimulus), calibration targets presented in the corners will not be viewable by the subject, and the standard calibration cannot proceed. Similar issues can arise if the head coil blocks part of the projection screen (e.g., with the Siemens 32 channel head coil, or some 8 channel head coils). This presents a problem if one is using the default approach of calibrating the entire screen, as calibration targets may appear in locations that cannot be viewed by at least one of the eyes, some of the time.

The EyeLink calibration target positions can be customized, so even if the area to calibrate is not rectangular, targets can be delivered anywhere in an automated fashion.

Having an observer or two (with highly variable head sizes) report from in the bore on the monocularly viewable areas of your display with each eye and map out the display coordinates that define the viewable area. A set of custom calibration points can be generated for your display region that distributes calibration points throughout the space that can be seen. For an example of how to configure such a custom calibration please see the discussion on the SR Research Support Forums: https://www.sr-support.com/forums/showthread.php?t=68.

Note that Experiment Builder's Camera Setup node has specialized support for customized calibration target positions and also has a facility for calibrating the eye tracker completely from within the scanner room if a fiber optic response device is available. Please see the Experiment Builder online help for the "Camera Setup" action, paying particular attention to "Customized Calibration Positions" and mention of "External Control".

#### *7.10.1.2 Simple Horizontal or Vertical Scaling of Target Positions*

A quick and easy to implement approach for simply scaling the horizontal or vertical extent of the calibration area is to use the `calibration_area_proportion`, and `validation_area_proportion` commands to set the proportion of the X and Y display area to use during calibration and validation. This can help when less than the entire display is viewable by subjects and is much quicker than redefining all of the calibration positions as it will scale the existing positions. Hence this approach is particularly useful when first trying to calibrate the eye tracker in a non-standard setting.

By changing these simple commands' X and Y values one can easily shrink the dispersion of the points in the horizontal or vertical dimension respectively. The commands as used below shrink to 88% of the X dimension of the display and 53% of the Y dimension of the display. Simply include these lines in your EYELINK:\ELCL\EXE\FINAL.INI or send them over the link as EyeLink commands from Experiment Builder or your favorite programming method. Note that default values for this command are 0.88 for X and 0.83 for Y.

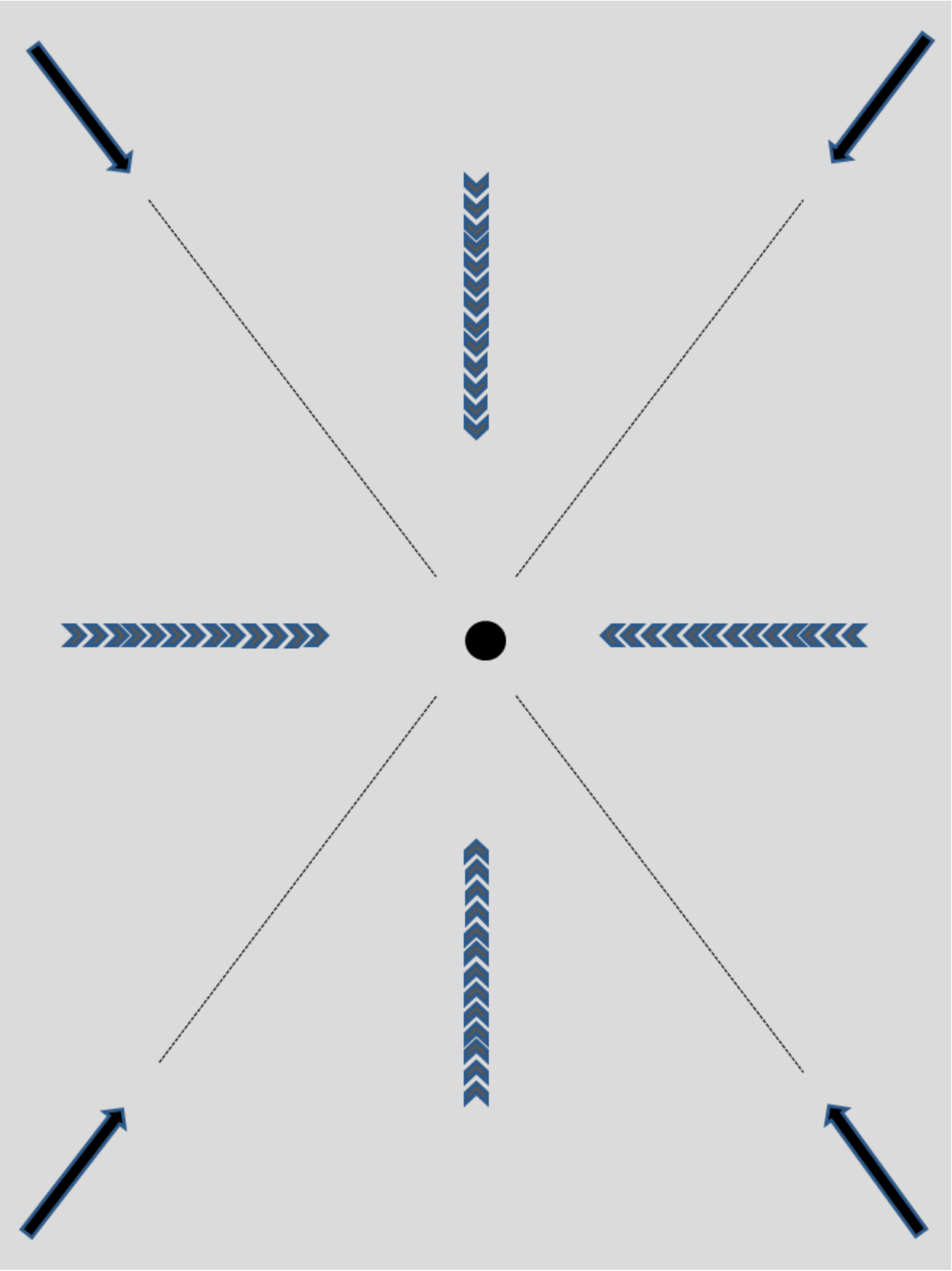
```
calibration_area_proportion 0.88 0.53
validation_area_proportion  0.88 0.53
```

### *7.10.2 Drift Correction*

The standard configuration of the 1000 Plus for behavioral laboratory use comes with Drift Correction disabled. When the 1000 Plus is used with the Long Range mount, small changes in pupil size or head position can translate to larger absolute inaccuracies given the larger eye-to-camera distances typically used. For this reason enabling drift correction may be desirable with the Long Range mount.

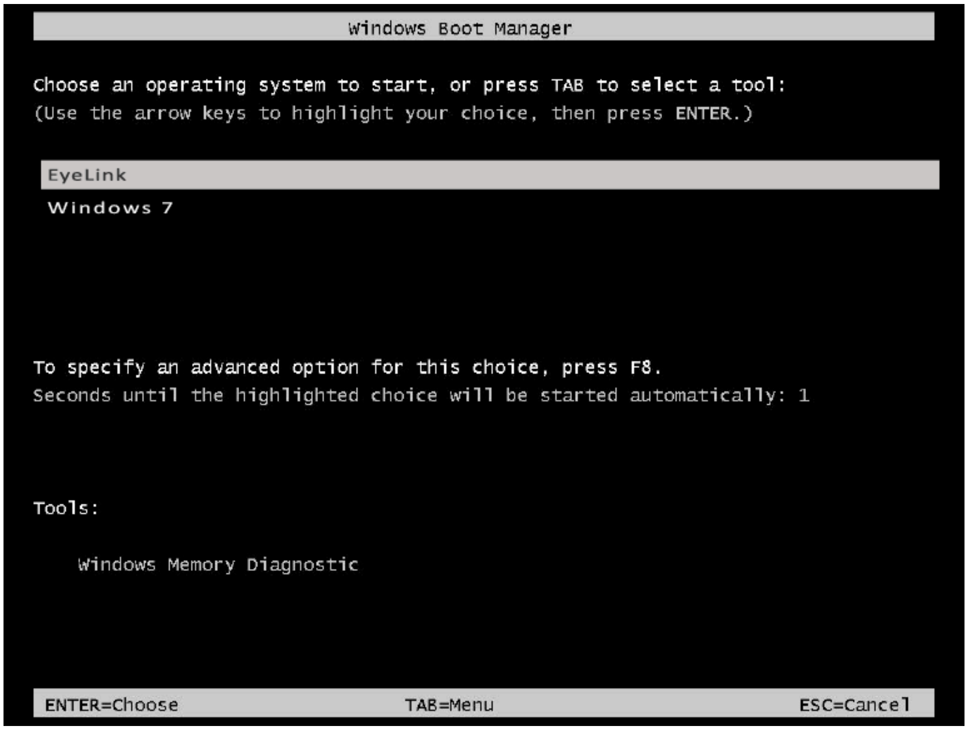
The 1000 Plus User Manual gives detailed information about enabling Drift Correction in several ways. Of particular interest for MEG.MRI users is online drift correction, whereby drift correction can be undertaken while recording is underway.

Please consult Section 3.11 of the User Manual for Drift Correction options.



# 8. Testing the Host PC Installation

Make sure you have plugged in the power supply of the EyeLink 1000 Plus camera, and connected the camera and Host PC using the network cable supplied with the system. Now turn on the Host PC. If your system shows the "Windows Boot Manager" interface, select the default "EyeLink" partition (see Figure 8-1).



```
Windows Boot Manager

Choose an operating system to start, or press TAB to select a tool:
(Use the arrow keys to highlight your choice, then press ENTER.)

 EyeLink
 Windows 7

To specify an advanced option for this choice, press F8.
Seconds until the highlighted choice will be started automatically: 1

Tools:

    Windows Memory Diagnostic

ENTER=Choose                 TAB=Menu                    ESC=Cancel
```

***Figure 8-1: Booting into the EyeLink Partition***

The EyeLink 1000 Plus Host application will start automatically. You will first see an EyeLink 1000 Plus splash screen, followed by the Camera Setup view of the Host application. Please make sure that you are using the latest version of the EyeLink 1000 Host software. The version of the Host software that is being used is displayed on the Splash screen as well as on the lower right corner of the Offline screen. The latest Host software can be downloaded from the SR Research support website http://www.sr-support.com and can be installed using the System Update tool (see section 8.1).

A screenshot of the large field of view of the EyeLink 1000 Plus camera (Desktop Mount) is illustrated in Figure 8-3. Please consult Chapter 3 “An EyeLink 1000 Plus Tutorial: Running an Experiment” of the EyeLink 1000 Plus User Manual for tutorials on settings up the camera, calibration, and validation. But first, please review the following sections of this user manual: section 8.4 “Customizing Screen Settings” and Chapter 9 “Display PC Hardware and Software Installation”.

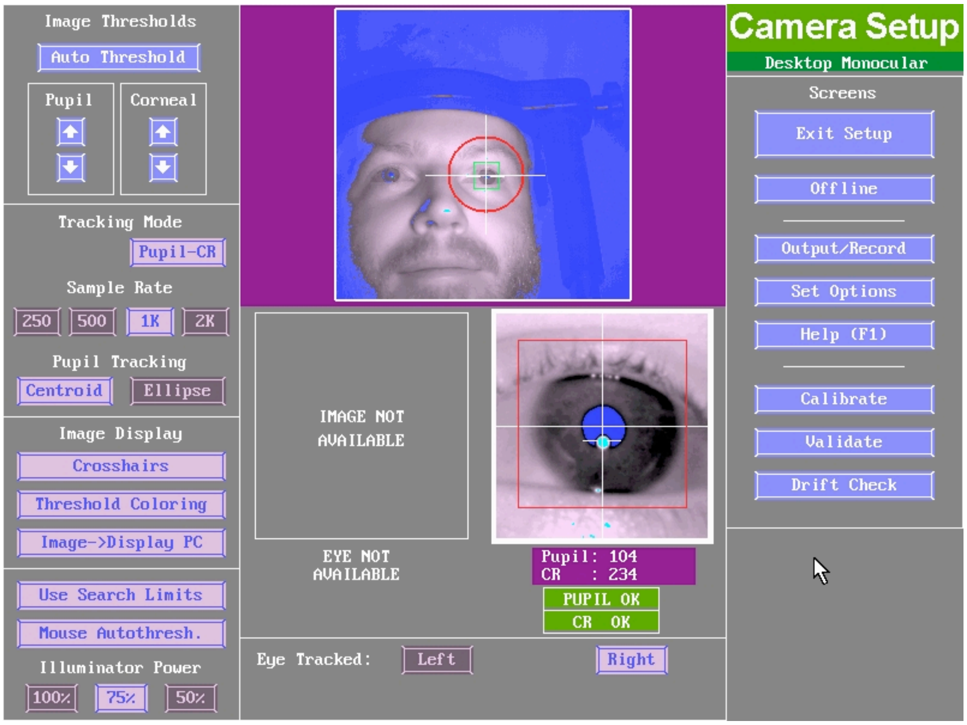
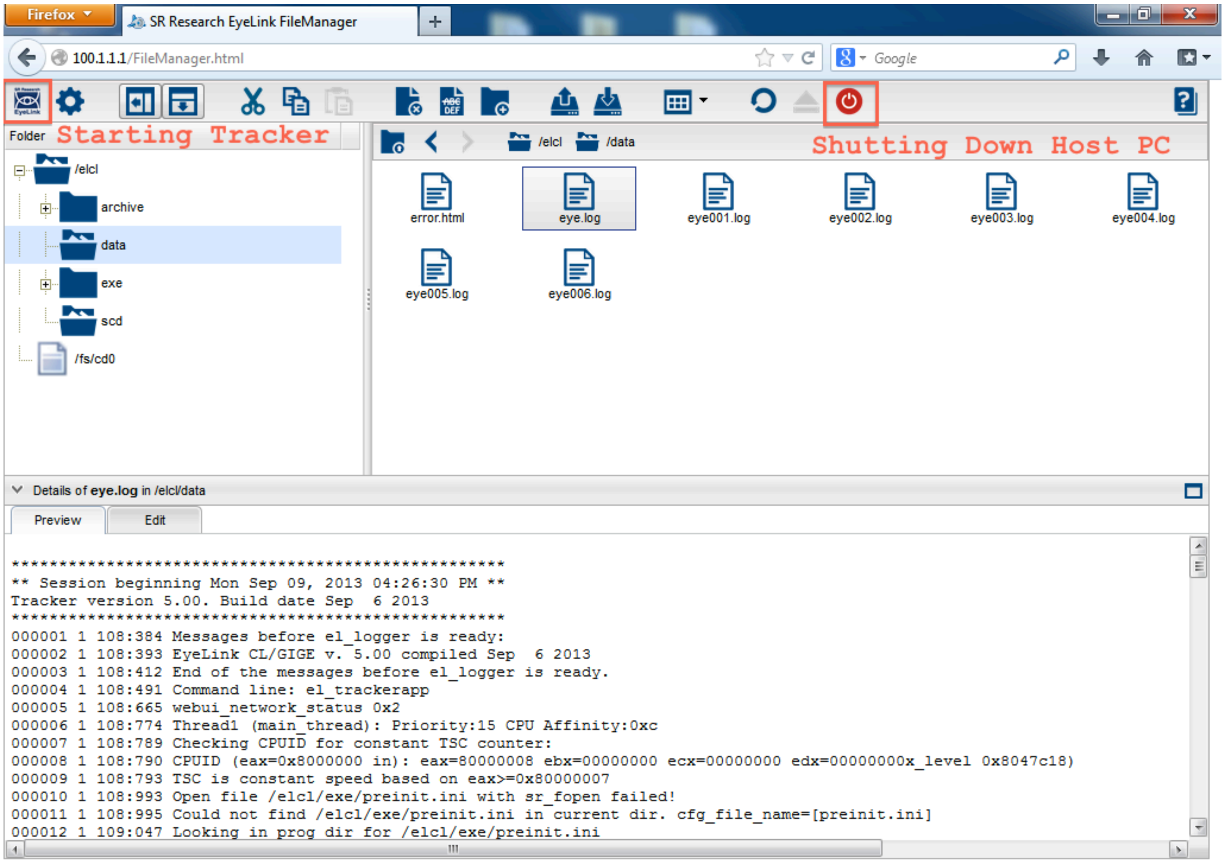


Image Thresholds
Auto Threshold
Pupil
Corneal
Tracking Mode
Pupil-CR
Sample Rate
250
500
1K
2K
Pupil Tracking
Centroid
Ellipse
Image Display
Crosshairs
Threshold Coloring
Image->Display PC
Use Search Limits
Mouse Autothresh.
Illuminator Power
100%
75%
50%
IMAGE NOT AVAILABLE
EYE NOT AVAILABLE
Pupil: 104
CR : 234
PUPIL OK
CR OK
Eye Tracked:
Left
Right
Camera Setup
Desktop Monocular
Screens
Exit Setup
Offline
Output/Record
Set Options
Help (F1)
Calibrate
Validate
Drift Check

*Figure 8-2: Host Application Camera Setup Screen*

From any screen on the Host Application, you can close the software by pressing Ctrl-Alt-Q three keys together on the Host PC keyboard (or go to the Offline screen and click on the "Exit EyeLink" button). This will bring you to the Web UI interface. Figure 8-3 is a screenshot of the Web UI interface running the File Manager (a detailed description of this interface can be found in section 2.1 "Web UI Interface" of the EyeLink 1000 Plus User Manual). From the Web UI interface, the Host application can be started by clicking on the tracker icon () on the toolbar. To turn off the Host computer, click the "Shutdown Host" button in the Offline screen of the Host Application, or click the "Shutdown" button () on the Web UI, and then press the power button.

In very rare cases, you may find yourself at the command prompt of the operating system. You can then either type **t** to restart the tracker application, **f** to go back to the Web UI interface, or **shutdown** to turn off the host computer.


Firefox
SR Research EyeLink FileManager
100.1.1.1/FileManager.html
Google
Folder
Starting Tracker
Shutting Down Host PC
/elcl
archive
data
exe
scd
/fs/cd0
/elcl
/data
error.html
eye.log
eye001.log
eye002.log
eye003.log
eye004.log
eye005.log
eye006.log
Details of eye.log in /elcl/data
Preview
Edit

```
****************************************************
** Session beginning Mon Sep 09, 2013 04:26:30 PM **
Tracker version 5.00. Build date Sep  6 2013
****************************************************
000001 1 108:384 Messages before el_logger is ready:
000002 1 108:393 EyeLink CL/GIGE v. 5.00 compiled Sep  6 2013
000003 1 108:412 End of the messages before el_logger is ready.
000004 1 108:491 Command line: el_trackerapp
000005 1 108:665 webui_network_status 0x2
000006 1 108:774 Thread1 (main_thread): Priority:15 CPU Affinity:0xc
000007 1 108:789 Checking CPUID for constant TSC counter:
000008 1 108:790 CPUID (eax=0x8000000 in): eax=80000008 ebx=00000000 ecx=00000000 edx=00000000x_level 0x8047c18)
000009 1 108:793 TSC is constant speed based on eax>=0x80000007
000010 1 108:993 Open file /elcl/exe/preinit.ini with sr_fopen failed!
000011 1 108:995 Could not find /elcl/exe/preinit.ini in current dir. cfg_file_name=[preinit.ini]
000012 1 109:047 Looking in prog dir for /elcl/exe/preinit.ini
```

**Figure 8-3: Example screen from Web UI Interface displaying File Manager**

## 8.1 Host Software Update

The EyeLink 1000 Plus host software installed on the eye tracker can be updated through the Web UI interface. First download the latest version of the Host software from our support website http://www.sr-support.com (go to "Downloads □ EyeLink Host Software □ EyeLink 1000 Plus Host software"). Copy the file to a computer that runs the Web UI. Click on the “Configuration” icon (⚙) on the File Manager toolbar, and then select “System Update” (◉). Now choose the “Update” tab (see Figure 8-4) and click on the "Browse ..." button to locate the intended host software installer and then click "Update". Wait until the host software is updated - please be patient as this process may take a few minutes to complete. In some rare cases, users may want to revert back to an earlier version of the Host software. The System Update tool has a "Rollback" tab that allows you to choose a particular version of the host software to revert to.

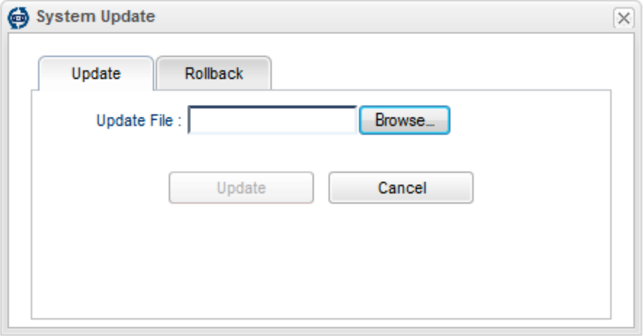


*Figure 8-4: Updating Host Software through Web UI*

## 8.2 Troubleshooting Instructions

If the Host Application fails to start, please watch closely for the error message displayed on the host screen. The complete error message is saved to the eye.log file in the "\elcl\data" folder and is retrievable through the File Manager. Try clicking on the tracker icon on the file manager to restart the Host Application. If the problem persists, please contact us (support@sr-research.com).

This section lists some of the error messages you may see when starting the host software.

### 8.2.1 SCD file does not exist

Each EyeLink 1000 Plus system requires a camera-specific .SCD file. If you see the following error when starting the eye tracker, please ensure the appropriate .SCD file is located in the "elcl\scd" folder of the Host PC. Use the File Manager to upload the particular SCD file if it is not there.

```
ERROR: Camera data file 'c:/ELCL/EXE/********.SCD' does not exist
```

You can find the camera-specific .SCD file in the Host Partition "\ELCL\SCD" directory of the "EyeLink 1000 Plus Software" USB drive that came with your system. If you cannot locate this file, please contact us.

### 8.2.2 ERROR: Can't find Gige Camera!

Sometimes, the Host Application will not start, with the following error displayed in the Web UI interface.

```
ERROR: Can't find Gige Camera!
```

Try first clicking on the tracker icon on the file manager to restart the host application. If the problem persists, try the following trouble-shooting tips:

1) Is the EyeLink 1000 Plus camera properly powered up? Check whether the indicator light on the camera Ethernet port is on. Try unplugging the camera power supply and then plug it back.

2) Are you using the black Ethernet cable supplied by us? The Ethernet cable should be a Cat6 network cable that supports gigabit connection.

3) Is the network cable for the camera plugged into the right port on the Host PC? If you are using a Workstation Host PC, the network cable for the camera should be plugged to the add-on network card (there should be an “EyeLink Camera” label on the card). If you are using a laptop Host PC, the cable for the camera should be plugged to the network port on the motherboard.

4) Is the network connection loose? You may try unplugging the cable and then firmly plugging it back in.

5) If the problem persists, please check out the information displayed on the “Configuration -> Network Settings” screen from the Web UI interface. Make a screen capture of what you see and email that to us (support@sr-research.com).

## *8.3 EyeLink Data Storage*

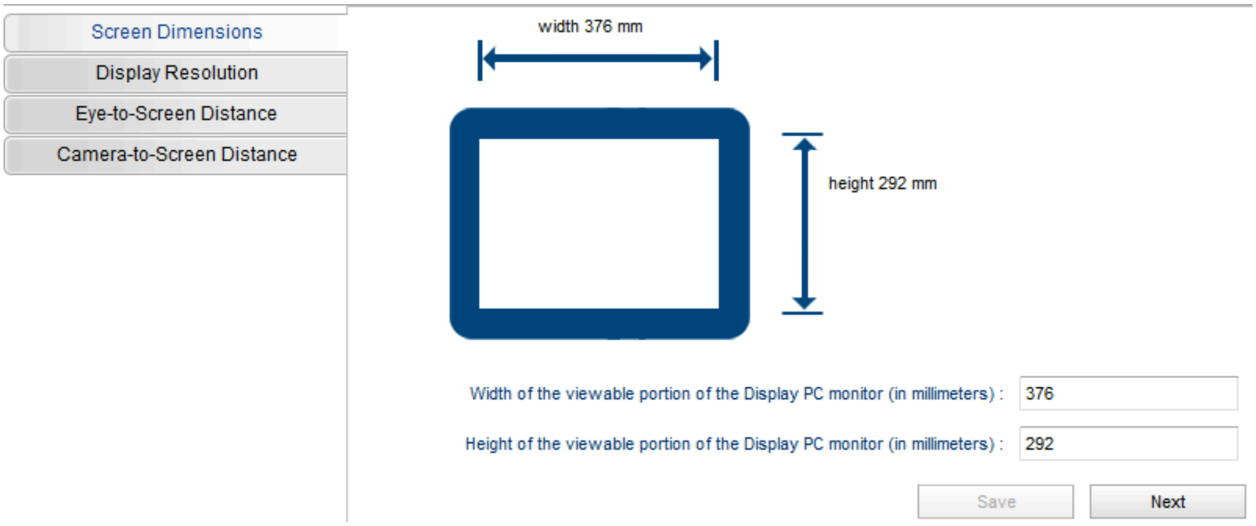
All eye tracker recording data files (.EDF) and log files (.LOG) that are created during an eye tracking session will be saved to the “\ELCL\DATA” folder of the Host PC. You can download the files using the File Manager (see section 2.1.1 “File Manager” of the EyeLink 1000 Plus User Manual).

## *8.4 Customizing Screen Settings*

To correctly compute visual angles, saccade amplitudes, and eye velocities, the EyeLink 1000 Plus eye tracker needs to know the physical characteristics of your setup. Any time you change your physical configuration (for example, if a new monitor is used, the eye-to-screen viewing distance is changed, etc.), you should use the Screen Settings tool to verify whether the parameters accurately reflect your current setup. The Screen Settings can be accessed by clicking on the “Configuration” icon (⚙) on the File Manager toolbar, and then select “Screen Settings” icon (🖥). The first three parameters of the Screen Settings interface (“Screen Dimensions”, “Display Resolution”, and “Eye-to-Screen Distance”) are important for all setups whereas the last parameter “Camera-to-Screen Distance” is important only for users of remote mode.

### *8.4.1 Screen Dimensions*

The "Screen Dimensions" screen lets the eye tracker know the size of the Display PC monitor that is being used in the experiments. All screen physical coordinate measurements are in millimeters. Turn on both the EyeLink 1000 Host PC and Display PC. Run your intended experiment (if you don't have one, use the Track example supplied). When the experiment starts up, measure the currently lit-up/viewable portion of the monitor. Please note that the monitor may adjust the lit up portion depending on the refresh rate and screen resolution used. For example, some wide screen monitors may have black edges when running experiments at non-native resolutions; the screen width and height should be measured as the lit-up portion of the display, excluding the black edges. Take down the measurements you have in millimeters and enter them in the following dialog box. Click "Save" and then press the "Next" button.



Width of the viewable portion of the Display PC monitor (in millimeters) : 376

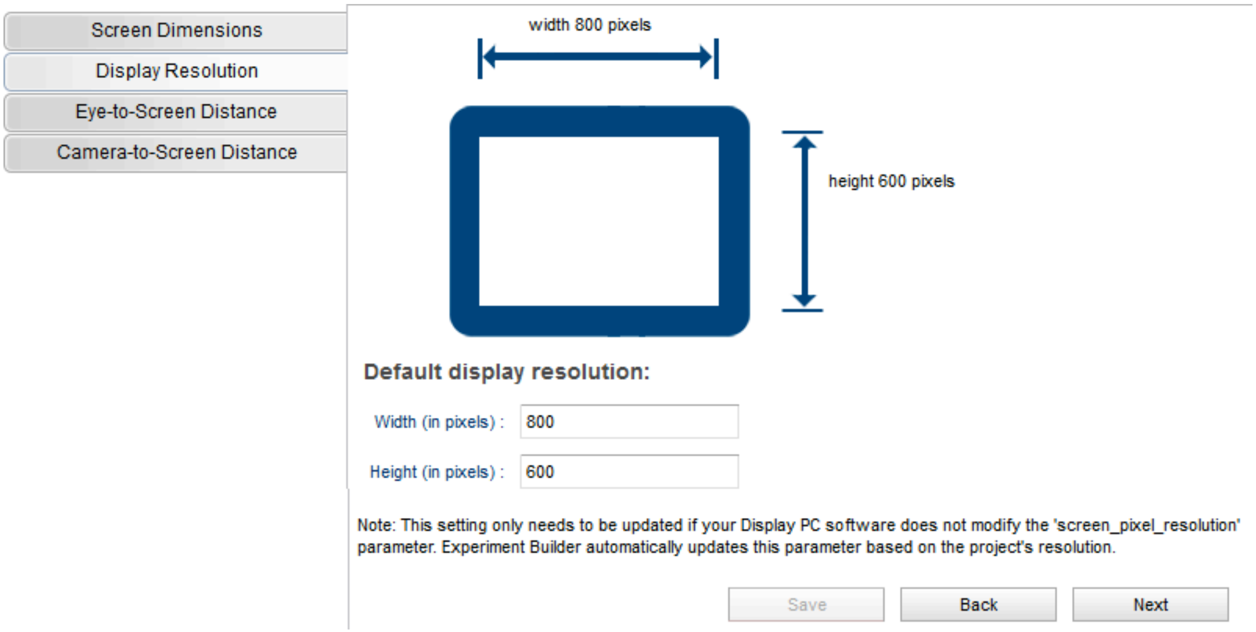
Height of the viewable portion of the Display PC monitor (in millimeters) : 292

*Figure 8-5: Updating Screen Dimensions*

### 8.4.2 Display Resolution

Now you will see a screen that lets you specify the resolution of the Display PC monitor when you run your experiments. If you are using SR Research Experiment Builder, then it will adjust this automatically at the start of an experiment, so you do not need to manually change this setting. If you are using other Display software (e.g., Psychtoolbox, E-Prime, Presentation), it is recommended that you configure the display resolution setting by sending the “screen_pixel_coords” command to the eye tracker in your experiment code (please see the examples that come with the EyeLink Display Software for an illustration of how this can be done). If the EyeLink Display Software is not being used (e.g., you are doing a stand-alone recording, or your own Display software doesn't send out the "screen_pixel_coords" command), then the default value for this parameter will apply. Please enter the resolution (e.g., 800 × 600 into the cells; see

Figure 8-6) and save the changes.



**Default display resolution:**

Width (in pixels) : 800

Height (in pixels) : 600

Note: This setting only needs to be updated if your Display PC software does not modify the 'screen_pixel_resolution' parameter. Experiment Builder automatically updates this parameter based on the project's resolution.

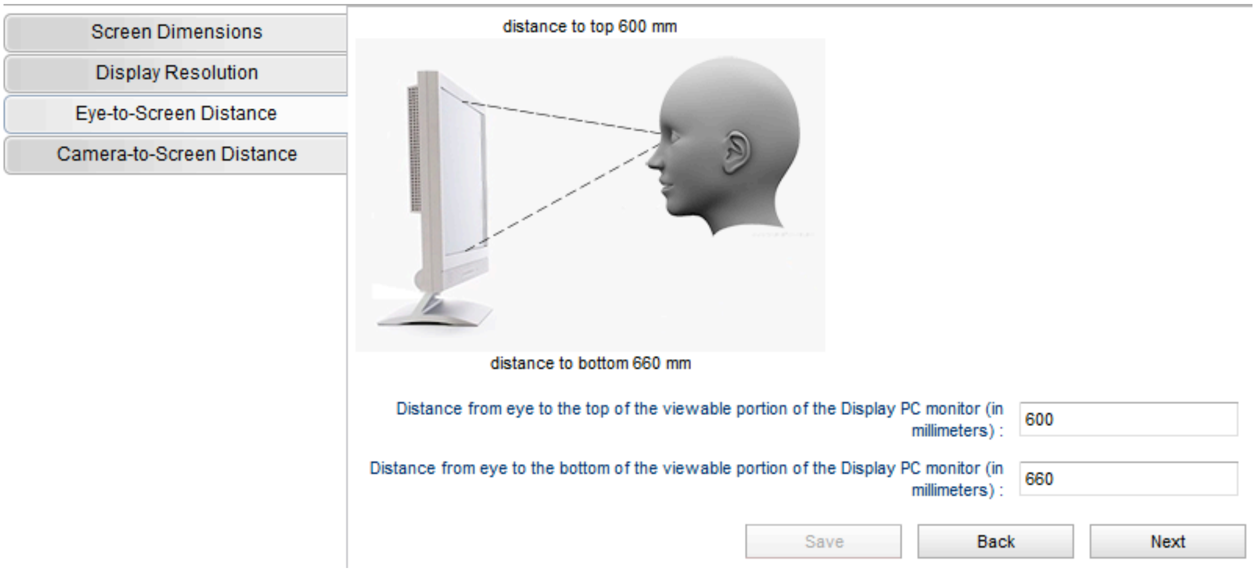
*Figure 8-6: Updating Display Resolution*

### 8.4.3 Eye-to-Screen Distance

Please follow the steps below to enter measurements that inform the eye tracker of the eye-to-screen viewing distance. For users of the Remote Mode of the eye tracker (using the target sticker), please keep the default "screen_distance" value.

1) For user of the Stabilized Head Mode of the eye tracker (Desktop, Arm, Tower, Primate, and Long-range mounts), set up the monitor and chinrest so that the chinrest is horizontally aligned with the monitor (HINT: measure from the left and right knobs on the chinrest to the left and right sides of the top of the display area of the monitor, these should be equal).

2) Adjust the height and tilt of the monitor such that when the participants are seated and looking straight ahead, their eyes are level with 75% of the monitor height. Monitor can be tilted up slightly. Now measure from the subject's eye to the top of the visible part of the display area, then from the eye to the bottom of the display area. Enter these two values (in millimeters) in the Eye-to-Screen Distance screen (see the figure below) and click the "Save" button.


Screen Dimensions
Display Resolution
Eye-to-Screen Distance
Camera-to-Screen Distance
distance to top 600 mm
distance to bottom 660 mm
Save
Back
Next

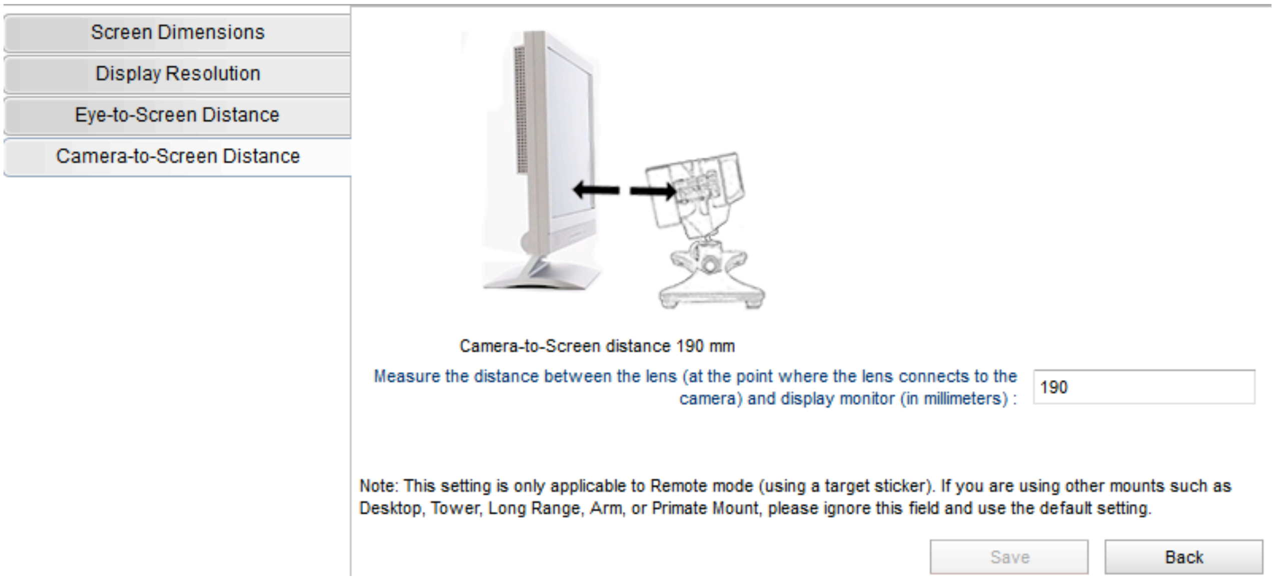
Distance from eye to the top of the viewable portion of the Display PC monitor (in millimeters) : 600

Distance from eye to the bottom of the viewable portion of the Display PC monitor (in millimeters) : 660

*Figure 8-7: Updating Eye-to-Screen Distance*

### 8.4.4 Camera-to-Screen Distance

For users of the Remote Modes (using a target sticker), it is recommended to place the Desktop Mount directly in front of the Display computer monitor with no extra space between Desktop Mount and the monitor. By default, the eye tracker software was designed to perform based on this recommended setup. However, in some setups (especially when a large display monitor is used), it is often necessary to move the monitor back while keeping the Desktop Mount at its optimal distance from the subject, so as to increase the distance between the subject and the screen while still ensuring that the eye tracker can track the subjects properly. In such cases, measure the distance (in millimeters) between the lens (at the point where the lens connects to the camera) to the display monitor. Enter the measured value in the following screen and click on the "Save" button.


Screen Dimensions
Display Resolution
Eye-to-Screen Distance
Camera-to-Screen Distance
Save
Back

Camera-to-Screen distance 190 mm

Measure the distance between the lens (at the point where the lens connects to the camera) and display monitor (in millimeters) : 190

Note: This setting is only applicable to Remote mode (using a target sticker). If you are using other mounts such as Desktop, Tower, Long Range, Arm, or Primate Mount, please ignore this field and use the default setting.

***Figure 8-8: Updating Camera-to-Screen Distance***

# 9. Display PC Hardware and Software Installation

The Display PC is used to run experiment application software for control of the EyeLink 1000 Plus tracker and stimulus presentation through the EyeLink Display Software. This API is available on Windows, Mac OS X and Linux platforms. The latest version of the display software can be downloaded from SR Research support website http://www.sr-support.com. The Display PC installation process should not take more than 15 minutes. Installation instructions for the Windows platform are detailed below.

## *9.1 Display PC Hardware Installation*

The requirements for the Display PC depend greatly on the type of experimental paradigms for which the EyeLink 1000 Plus will be used. For example, gaze-contingent paradigms generally require more computing power than simple cognitive paradigms because the computer display needs to be updated as quickly as possible. Similarly, video and audio intensive experiments may need faster hard disks to support the transfer of large video file data to the computer in a timely manner. The following requirements are *suggestions* for a Display PC configuration that should be able to handle most experimental requirements. Please contact a SR Research Ltd. representative if you have specific questions about your situation and would like our input.

- Recent Intel CPUs with duo-core/multi-core processor
- 250 GB or larger hard disk with 7,200 or higher rpm, or solid-state hard drive
- 1.0 GB or more PCIx video card supporting vertical refresh rates of at least100 Hz
- At least 4 GB RAM
- A DVD-ROM writer for software installation and data backup
- 32-bit or 64-bit Windows 7; or Mac OS X 10.6.8 or higher
- 17" or larger CRT monitor (for valid timing synchronization), that supports vertical refresh rates of >= 100Hz (10 ms frames) and horizontal refresh rates of at least100 kHz
- A dedicated Ethernet port to connect Display PC to the EyeLink 1000 Plus Host PC
- Optional Ethernet card for use on local network or internet access
- A keyboard and mouse
- Free USB ports (if EyeLink Data Viewer/SR Research Experiment Builder is purchased.

Set up the Display PC at the desired location (see Section and Figure 1-1 for a suggested layout). This includes connecting the keyboard and mouse to the computer, as well as the power supply and monitor cables.

## 9.2 Windows Installation

To use a Windows Display PC with the EyeLink 1000 Plus eye tracker, various EyeLink software components should be installed. The installation process consists of the following basic steps:

- Install the EyeLink Experiment Programming Kit.
- Install the EyeLink Data Viewer and/or Experiment Builder software (if purchased).
- Install the USB Key drivers for EyeLink Data Viewer and/or Experiment Builder software (if purchased).
- Configure the network connection to the EyeLink 1000 Plus Host PC.

### 9.2.1 Installing the EyeLink 1000 Plus Experiment Programming Kit

The Windows Display Software (API and example files) is available in the "Display PC Installation" directory of the "EyeLink 1000 Plus Software" USB drive. To install the toolkit:

1. Insert the "EyeLink1000 Plus Software" USB drive to the Display PC.
2. Open the "Display PC Installation -> Windows" folder.
3. Copy the EyeLinkDevKit_*.exe to the computer desktop. Run the installer by double clicking the icon.
4. Follow the instructions from the InstallShield Wizard to install the display software.
5. Wait for the InstallShield Wizard to finish, and click FINISH to complete installation.

### 9.2.2 Installing the EyeLink Data Viewer and Experiment Builder Software

The EyeLink Data Viewer and Experiment Builder software are optional Windows applications for the EyeLink eye tracker. If you did not purchase these options this section may be skipped, or you may install the software for evaluation in demo mode.

1. Insert the "EyeLink1000 Plus Software" USB drive to the Display PC.
2. Open the "Display PC Installation -> Windows -> EyeLink Data Viewer" folder.
3. Copy the EyeLinkDV_*.exe to the computer desktop. Run the program by double clicking on the icon.
4. Follow the instructions from the InstallShield Wizard to install the software.
5. Wait for the InstallShield Wizard to finish, and click FINISH to complete installation.
6. Open the "Display PC Installation -> Windows -> SR Research Experiment Builder" folder
7. Copy the SREB_*.exe to the computer desktop. Run the program by double clicking the icon and follow the instructions from the InstallShield Wizard.

### 9.2.3 USB License Key Installation

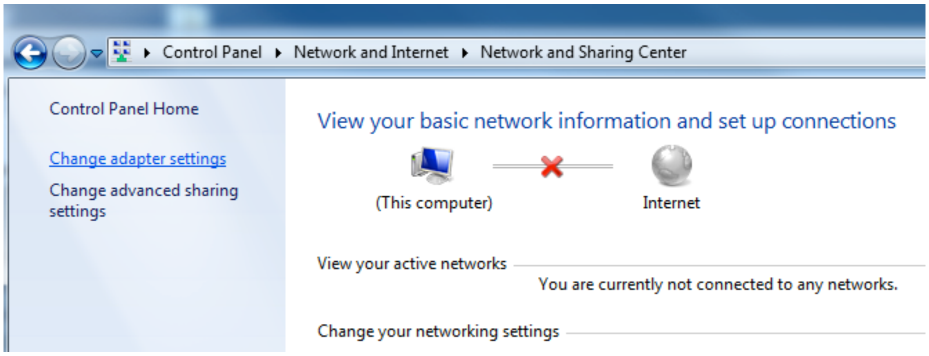
If you purchased either the EyeLink Data Viewer or SR Research Experiment Builder software, you will have been provided with a USB license key with your order. To install the software driver for the USB license key follow these steps:

1. From the Windows Start menu select “Start -> All Programs -> SR Research -> Install HASP Driver”.
2. Follow the instructions from the InstallShield Wizard to install the software.
3. Wait for the InstallShield Wizard to finish, and click FINISH to complete installation.
4. Insert the USB Key into an available USB port on the Display computer. The USB key should start to glow red, indicating that the key has been recognized by the system.

### 9.2.4 Setting up 1000 Plus Network Connection

You must have an Ethernet port in your Display Computer for the connection to the EyeLink Host PC. Allow Windows to install drivers for it (if it is new hardware), then follow these instructions to configure the TCP/IP network protocol. These instructions are based on Windows 7; other Windows operating systems may vary slightly.

1. From the Start menu select “Control Panel”.
2. Click on the “Network and Internet Connections” icon, and then select the “Network and Sharing Center” icon. In the following Screen, choose “Change Adapter Settings” icon on the left side panel (see Figure 9-1).


Control Panel ▸ Network and Internet ▸ Network and Sharing Center
Control Panel Home
Change adapter settings
Change advanced sharing settings
(This computer)
Internet
View your active networks
Change your networking settings

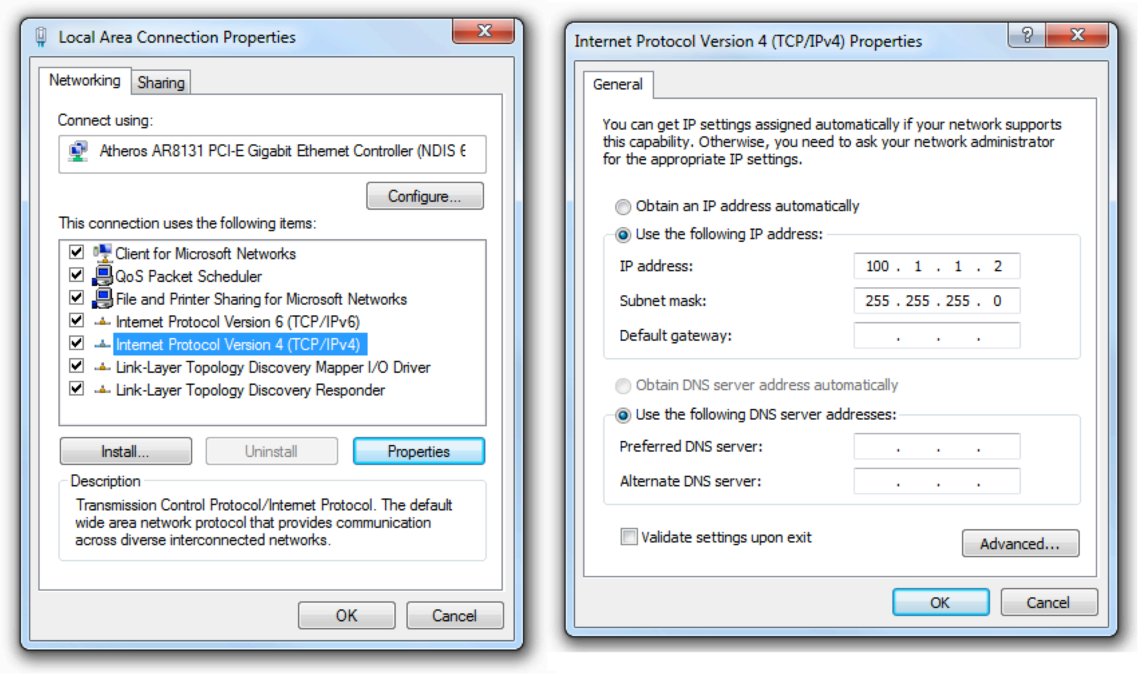
View your basic network information and set up connections

You are currently not connected to any networks.

*Figure 9-1: Choose “Change Adapter Settings” Option on*

3. Check the list of installed components to make sure a network card is installed. If not, install a driver for the card.
4. Double click on the network card icon that represents the network card that will be connected to the EyeLink 1000 Plus Host PC.
5. Select the “Properties” button.
6. Select the “Internet Protocol Version 4 (TCP/IPv4)” and then click on the “Properties” button (see Figure 9-2).

7. Select the “Use the following IP address” radio button. Enter the IP address of “`100.1.1.2`”. The last digit of the IP address can increase for other computers on the EyeLink network. Enter the subnet mask of “`255.255.255.0`”. Leave the default gateway and other settings blank (see Figure 9-2).



Connect using:

Atheros AR8131 PCI-E Gigabit Ethernet Controller (NDIS 6

This connection uses the following items:

- ☑ Client for Microsoft Networks
- ☑ QoS Packet Scheduler
- ☑ File and Printer Sharing for Microsoft Networks
- ☑ Internet Protocol Version 6 (TCP/IPv6)
- ☑ Internet Protocol Version 4 (TCP/IPv4)
- ☑ Link-Layer Topology Discovery Mapper I/O Driver
- ☑ Link-Layer Topology Discovery Responder

Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

○ Obtain an IP address automatically

● Use the following IP address:

IP address: 100 . 1 . 1 . 2

Subnet mask: 255 . 255 . 255 . 0

Default gateway: . . .

○ Obtain DNS server address automatically

● Use the following DNS server addresses:

Preferred DNS server: . . .

Alternate DNS server: . . .

☐ Validate settings upon exit

***Figure 9-2: Configure IP address on Windows 7***

8. Click on “OK” to return to the Properties dialog. Click “OK” again to save your changes. Click “Close” to exit from the network card dialog.

To test the network connection, start the EyeLink 1000 Plus tracker and start the “Track” application from “Start -> Programs -> SR Research -> EyeLink -> Track”. The link should connect, and the screen will display instructions. This application allows you to practice participant setup and test the system. If the message “Cannot initialize link” appears, the TCP/IP protocol or crossover cable is/are not properly configured. If the connection times out, it is probably due to the network card being improperly configured or because the network cable is not connected to both PCs. On the Workstation Host PC, the Ethernet cable should be connected to the Ethernet port with an “EyeLink Display Ethernet” label. On the Laptop Host PC, the Ethernet cable should be connected to the USB Ethernet converter. Make sure you first plug in the USB converter before powering up the laptop.

## *9.3 Mac OSX Installation*

To use Mac OS X as a Display computer with the EyeLink 1000 Plus system, various EyeLink software components should be installed on the computer. The installation process consists of the following basic steps:

- Install the “Mac OS X Display Software”. The installer disk image is located in the “Display PC Installation/Mac OS X” folder of the “EyeLink 1000 Plus Software” USB drive – the latest version of the software can be downloaded from SR Research Support website (https://www.sr-support.com/forums/showthread.php?t=15).

  Mount and open the disk image under Mac OS, then click on the installer and follow the instructions, using the default settings as prompted. The EyeLink libraries, documentation and source code examples are installed in the “Applications -> EyeLink” folder.

- Install the EyeLink Data Viewer, if you have purchased the software license. The installer disk image is located in the “Display PC Installation/Mac OS X” folder of the “EyeLink 1000 Plus Software” USB drive – the latest version of the software can be downloaded from SR Research Support website (https://www.sr-support.com/forums/showthread.php?t=10).

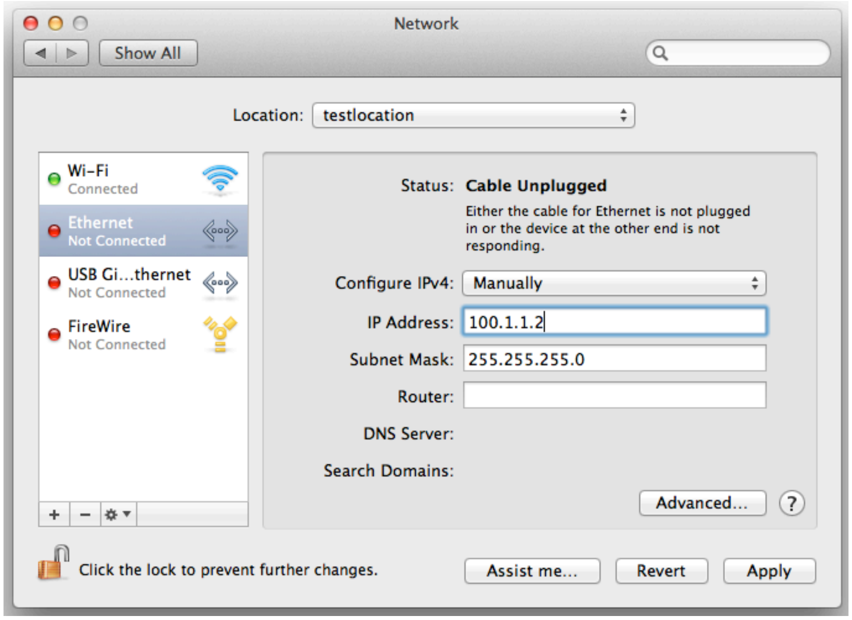
  Mount and open the disk image under Mac OS, then click on the installer and follow the instructions, using the default settings as prompted. Data Viewer is installed in the “Applications -> EyeLink DataViewer” directory.

- Install the USB HASP Key driver for EyeLink Data Viewer. Mount the “Hdd_MacOSX.dmg” disk image to get access to the HASP driver installer. Double click on the installer made available by the disk image and follow the instructions, using the default settings as prompted.

- Install the SR Research Experiment Builder, if you have purchased the software license. The installer disk image is located in the “Display PC Installation/Mac OS X” folder of the “EyeLink 1000 Plus Software” USB drive – the latest version of the software can be downloaded from SR Research Support website (https://www.sr-support.com/forums/showthread.php?t=9).

  Mount and open the disk image under Mac OS, then click on the installer and follow the instructions, using the default settings as prompted. Data Viewer is installed in the “Applications -> ExperimentBuilder” directory.

- Configure the network connection to the EyeLink 1000 Plus Host PC. Set the IP address to 100.1.1.2 and subnet mask to 255.255.255.0. You can do this by opening the System Preferences (Apple menu item, then select ‘System Preferences…’) and click on the Network Icon. Next go to your computer’s Built-In Ethernet device, select Manually on the Configure pop-up menu, and enter the above IP address and subnet mask (see Figure 9-3). Click Apply to apply these new settings.


Network
Show All
Wi-Fi
Connected
Ethernet
Not Connected
USB Gi…thernet
Not Connected
FireWire
Not Connected
Advanced…
?
Assist me…
Revert
Apply

Location: testlocation

Status: **Cable Unplugged**

Either the cable for Ethernet is not plugged in or the device at the other end is not responding.

Configure IPv4: Manually

IP Address: 100.1.1.2

Subnet Mask: 255.255.255.0

Router:

DNS Server:

Search Domains:

Click the lock to prevent further changes.

***Figure 9-3: Configure IP address on Mac OS X***

If you plan to program your experiments in MatLab, install the latest version of the PsychToolBox and reboot the computer. Some demo examples can be found in the Psychtoolbox directory which is in the Applications folder at: "Applications/Psychtoolbox/PsychHardware/EyelinkToolbox/EyelinkDemos/GazeContingentDemos".

# 10. Appendix A: Optional Host PC Hardware Installation

Your Host PC should be shipped to you preconfigured. If you purchase additional components (Analog card, or PCI express Parallel Port card) at a later time, then you will need open the computer chassis to install those cards yourself. Therefore, put the computer case in a position where you can easily access the computer's PCI slots.

**IMPORTANT: Switch off the computers before installing any add-on cards or connecting or disconnecting any cables! Ensure that all cabling is properly connected and connectors are properly secured to the Host PC and the EyeLink1000 Plus camera before use.**

**WARNING: Static Electricity Discharge may cause permanent damages to your system. In order to avoid possible static electricity discharge during installation, please discharge any static electricity accumulated in your body by touching a grounded metal surface or the computer case for a few seconds.**

**IMPORTANT: Handle the cards only by their edges.**

## *10.1 Installing the Data Translation Analog Card (Optional)*

If the analog output option was purchased with your system, then insert the Data Translation Analog output card into a free PCI slot. Ensure the card's bracket is firmly attached to the PC. Close the computer chassis and reconnect the power supply to the computer.

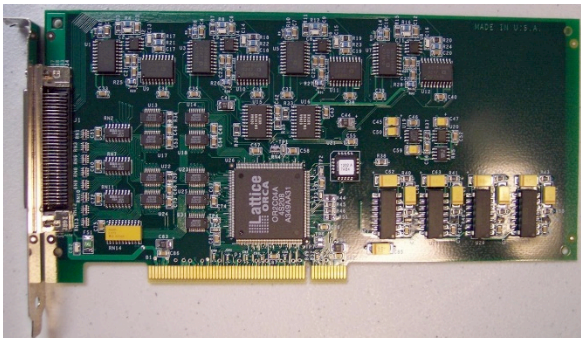


***Figure 10-1: PCI Analog Card***

## *10.2 Installing the PCI Express Parallel Port (Optional)*

Your Workstation Host PC should already come with a parallel port for communicating with other devices or receiving button response. If an additional PCI express version of the parallel port card is purchased after you received the Host PC, then insert the parallel port add-on card into a free PCI slot. Ensure the card's bracket is firmly attached to the PC. Close the computer chassis and reconnect the power supply to the computer.

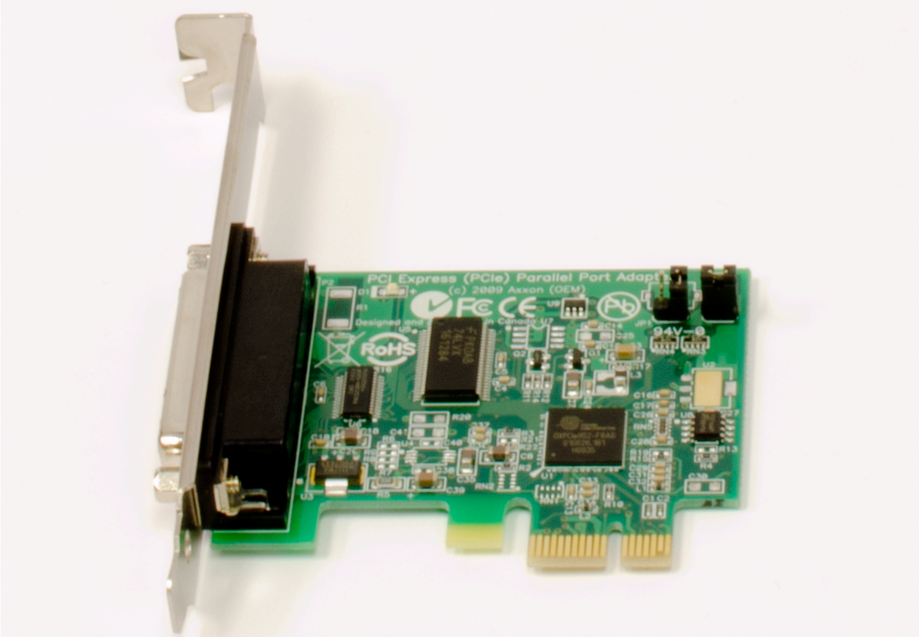


*Figure 10-2: PCI Express Parallel Port Add-on Card*